On point-force elastic problem for a functionally graded coating on an homogeneous half-space

Roberta Sburlati
DICAT, University of Genova,Via Montallegro, 1- 16145 Genova, Italy
sburlati@dicat.unige.it

January 24, 2011

Functionally graded materials (FGM) are currently actively explored in coating design for the purpose of eliminating the mismatch of thermomechanical properties at the interface and thus increasing the resistence of coatings to functional failure. Many of present and potential applications of graded materials involve contact or impact problems which are mostly load transfer problems and, consequently, the main interest of some papers is to pay attention to basic elasticity problems of inhomogeneous solids [Martin, 2002; Kashtalyan, 2008]. In this paper, three-dimensional elastic deformation of a exponentially graded coating deposited on a homogeneous half-space and subjected, on the free surface, to point load described by Green's function is investigated. The solution is obtained by using a Plevako's representation form which reduces the problem to the construction of a potential function satisfying a linear fourth-order partial differential equation [Plevako, 1971]. We write this potential function in terms of a Bessel expansion with respect to the radial coordinate and, due to the local effect interest near the load, we assume the half-space domain hypotheses and perfectly bonded interface conditions between the coating and the substrate [Sburlati, 2010]. In this way we explicitly obtain the solution for the Green's function on the coating surface and a comparative study of FGM versus homogeneous coating is conducted to examine the effect of the coating type on stress and displacement fields in the system.

Martin, P. A., Richardson, J. D., Gray, L. J. & Berger, J. R. 2002 On Green's function for a three-dimensional exponentially graded elastic solid. *Proc. R. Soc. London A* **458**, 1931-1947 (DOI 10.1098/rspa.2001.0952).

Kashtalyan, M. & Menshykova, M. 2008 Three-dimensional analysis of a functionally graded coating/substrate system of finite thickness. *Proc. R. Soc. London A* **366**, 1821-1826 (DOI 10.1098/rsta.2007.2194).

Plevako, V. P. 1971 On the theory of elasticity of inhomogeneous media. *J. Appl. Math. Mech.* **35**, 806-813 (10.1016/0021-8928(71)90078-5).

Sburlati, R., Bardella, L. 2010 Three-dimensional elastic solutions for functionally graded circular plates. *Eur. J. Mech. A-Solid.* in press (DOI 1016/j.euromechsol.2010.12.008).