THE REFINED THEORY OF MAGNETOELASTIC RECTANGULAR PLATES

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Cheng [1] gave a refined plate theory from Boussinesq-Galerkin elasticity solution and Lur'e method without ad hoc assumptions. The refined plate theory consists of three parts: the biharmonic equation, the shear equation and the transcendental equation. Zhao and Wang [2] also obtained Cheng's refined theory from Papkovich-Neuber solution and strictly proved that it consists of preceding three parts. Recently, Gao and Wang [3, 4] extended [2] for the narrow rectangular isotropic elastic beams and magnetoelastic beams, and derived the refined theory of beams.

Based on the linear theory of magnetoelasticity, this paper presents the theory for a soft ferromagnetic elastic plate by using the method developed by Ref. [3, 4]. From general solution of magnetoelastic equation and Lur'e method, a refined theory for magnetoelastic plate has been deduced systematically and directly from linear magnetoelasticity theory. In the case of homogenous boundary conditions, the refined plate theory is exact in the sense that a solution of the refined plate theory satisfies all the balance equations in the magnetoelasticity theory, and consists of four parts: the biharmonic equation, the shear equation, the transcendental equation and the magnetic equation. In the case of non-homogenous boundary conditions, the approximate governing equations and solutions are accurate up to the second-order terms with respect to plate thickness. For the above-mentioned two cases, the governing equations and solutions of elastic plates can be obtained directly from the corresponding magnetoelastic equations and solutions by omitting the magnetic fields effect. When the applied force is absent, the new magnetoelastic theory for the loading plate can still be justified by comparing its form with that of other well-known magnetoelastic theories. Therefore, in these cases the refined magnetoelastic plate theory should be a very accurate one.

References

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