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含孔软铁磁材料Mindlin板中弹性波散射问题

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摘要　基于考虑磁弹相互作用的Mindlin板弯曲波动方程，采用波函数展开法，分析研究了含孔软铁磁材料Mindlin板中弹性波散射与动应力集中问题，给出了问题的分析解和数值算例. 通过分析发现：磁感应强度对动弯矩集中系数和动剪力集中系数有增加的作用，特别是在低频的情况下.

关键词　Mindlin厚板,弹性波散射,磁弹耦合动力学,软铁磁材料,动应力集中

分类号

Scattering of flexural waves in mindlin's plates of soft ferromagnetic materials with a cutout

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Abstract

The problem of elastic waveguide and dynamic stress concentrations in plates with a cutout is the important subject in solid mechanics. The cutout in structures has influence directly on the loading capacity and the lifetime of structures, therefore, some researchers have devoted to theoretical analysis and experimental research in the world. Considered dynamic stress concentration or intensity factors, the classical theory of thin plate has disadvantage. Thick plate theory proposed by Mindlin made up for the shortage classical theory of thin plate including the effect of transverse shear deformation and rotator inertia. The satisfying result is gained in engineering. In the 1960's, with wave function expansion method, Pao Yih-Hsing first studied the problem of the flexural wave scattering and dynamic stress concentrations in Mindlin's thick plates with circular cavity and gave an analytical solution and numerical results. With the development of modern science and technology, the ferromagnetic materials have been applied to superconduct nuclear power station and magnetic levitation trains. It has better physical and mechanical property. The stress on the contour of a cavity or crack in ferromagnetic materials may be increase in a uniform magnetic field. It has a influence on the carrying capacity and the lifetime of structures. According to the many references, the dynamical behavior of ferromagnetic elastic structures can be significantly affected by the presence of a uniform magnetic field. Based on the theory of magneto-elastic interaction, Japanese researchers analyzed scattering of flexural wave and the dynamic bending moment intensity factors in cracked Mindlin plates of ferromagnetic materials and gave numerical results. They used Fourier transforms to reduce the mixed boundary value problem to a Fredholm integral equation that can be solved numerically. In this paper, based on the equation of wave motion in Mindlin's plate of magneto-elastic interaction, using wave function expansion method, the scattering of flexural wave and dynamic stress concentrations in a plate of ferromagnetic materials with a cutout are investigated. According to analysis and numerical results, the magnetic induction intensity has great influence on the dynamic stress concentration factors at low frequency.

Key words Mindlin's thick plate　scattering of elastic waves　dynamics of magneto-elastic interaction　soft ferromagnetic materials　dynamic stress concentration

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