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FLEXURAL WAVE SCATTERING BY A CIRCULAR HOLE IN RECTANGLE THIN PLATE

Abstract

In mechanical engineering and aerospace engineering, thin plate structure is used widely. For the sake of fixing bolt, it often design open holes in the plate. When the plate is overloaded or the load is changed regularly, flexural wave is propagating in the plate. Because there are holes, it can cause stress concentration. Stress concentration could decrease the bearing capacity of structure, and reduce the service life of structure. The problem of flexural wave scattering by holes in the plate is one of the important and interesting questions in aerospace engineering for the latest decades. There are lots of materials obtained by theoretical research and experimental investigation. The problem is complicated, because there are many factors influenced. It is hard to obtain analytic solutions except for several simple conditions. In this paper, based on the theory of elastic thin plate, by using wave function expansion method and sector similarity method, scattering of flexural wave and dynamic stress concentration by a circular hole in the rectangle thin plate are investigated. Rectangle plate could be seen as a sector with big radius and small angle. In the complex plane, the displacement field aroused by incident wave could be given by using mathematics method, and the scattering displacement field impacted by circular hole comprised of Fourier-Bessel series with undetermined coefficients could be constructed. Through applying the method of moving complex coordinate, the equations with unknown coefficients can be obtained by using the stress-free condition along the circular hole and sector arc boundary in the radial direction. According to orthogonality condition for trigonometric function, these equations can be reduced to a series of algebraic equations. Then the value of the unknown coefficients can be obtained by solving these algebraic equations. So the analytical solution of this problem is obtained. By using the displacement and stress expressions, an example is provided to show the effect of the change of relative location of the circular hole.