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DESIGN GUIDELINES FOR IN-PLANE FREE VIBRATION AND DYNAMIC STABILITY OF HIGH SPEED ROTATING DISCS

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Analytical methods are presented for determination of free vibration analysis of high speed viscoelastic rotating discs. In addition, the effects of embedded material on the discs for the dynamic stability and the development of a design guideline for these systems are investigated. The analysis is conducted by employing the two dimensional elastodynamic theories and the viscoelastic material for the medium is allowed by assuming complex elastic moduli. The general governing equations of motion are derived and their solutions are established. In this study, different boundary conditions such as: free-free, fixed-free and free-fixed for annular rotating discs are considered. Moreover, the influences of hysteretic material damping on dimensionless natural frequencies and modal loss factors of the rotating discs are also determined. Furthermore, the influence of attached materials on the inner or outer sides of discs for controlling the natural frequencies and critical speeds are presented. The dimensionless results for natural frequencies, various modal displacements and stresses, and critical speeds are presented for a wide range of rotational speeds and radius ratios. To verify the computed results, results for some cases were compared to previously established results. These results are essential for design of such discs; thus, they are provided in tables and are depicted in a number of design charts.

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