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VIBRATIONS OF PLATES WITH CURVED EDGES CONSIDERING INTERNAL SUPPORTS BY THE BOUNDARY ELEMENT METHOD

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The natural vibrations of thin (Kirchhoff) plates of curved edges are considered in this paper. Circular and elliptic plates supported on boundary and additionally resting on internal columns or continuous supports are analysed using the Boundary Element Method. The boundary and domain integral equations are derived using Betti's theorem taking account of an alternative formulation of boundary conditions [1]. Internal supports and inertia forces are introduced using the Bèzine approach [2]. Three types of boundary elements are introduced: rectilinear, simplified curvilinear, both of the constant type, and three node isoparametric curvilinear. Boundary integrals are calculated using singular and non-singular approaches for rectilinear elements and non-singular approach for curvilinear elements with modified localisation of integration points [3]. Additionally the boundary and domain intergral equations are formulated using double collocation point approach.

Constraints inside a plate domain are modeled as punctual or column supports of a square cross-section with one central collocation point associated with one unknown value in the form of a reaction force as well as continuous constraints where a plate is supported along curved or rectilinear lines which are divided into a finite number of sections where each of them is associated with one collocation point.

One of several considered examples is the elliptic steel plate of its half-axis dimensions 3.0m x 2.0m and thickness 0.01m, which is resting only on four internal column supports located symmetricaly on two axes of symmetry (1.5m and 1.0m from the ellipse centre in two perpendicular direction in reference to half-axes). The number of rectilinear boundary elements is 64, the number of lumped masses is 128. Natural frequencies [rad/s] from the first to fifth are respectively: 13.618 (13.728), 18.112 (17.754), 18.681 (18.631), 19.428 (19.116), 28.696 (28.659). Results in round brackets are given by the FEM [4].

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