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Dynamic Characteristic Analysis of Cracked Cantilever Beams under Different Crack Types

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Abstract.

In order to simulate the complicated dynamic phenomena of cantilever beam structures with different crack types and levels in the engineering machinery, three types of cracks are assumed, i.e., non-penetrating parabolic crack (NPPC), penetrating trapezoid crack (PTC) and uniform-penetrating crack (UPC). Based on ANSYS software, mixed elements combining beam elements and solid elements are adopted to establish the finite element (FE) models of cracked cantilever beams where the crack levels are evaluated by introducing the area damage factor, i.e., the ratio of the damage area to the cross-sectional area. Then vibration responses and crack level identification of the system under three cases of crack severity are discussed by the spectrum cascades, acceleration-velocity and velocity-displacement phase portraits, and contact pressure nephograms. The results show that the magnitudes of constant components in the spectra increase with the increase of crack severity. Lateral velocity-displacement phase portraits, perpendicular to the excitation direction, are more sensitive to the appearance of the small crack than acceleration-velocity phase portraits in the excitation direction, and the combination of the two phase portraits can be used to identify the crack severity. The crack breathing effects can be evaluated using contact pressures distributions, and local contact phenomenon can be observed during the

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