EFFECT OF PARTICLE SIZE ON THE VIBRATION OF PLATES LOADED WITH GRANULAR MATERIAL

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Acoustic methods of landmine detection are emerging as reliable techniques that are especially well suited for non-metallic mines. These methods rely on the vibrations of the top plate of the mine as it responds to the acoustic excitation. The plate response is complicated by the interaction with the surrounding soil. If the loading soil is granular (e.g., sand), it is expected that particle size will influence the mine response. Experimental results related to this hypothesis are presented here. The first resonant frequency of a sand-loaded plate is measured as a function of sand mass for dry sand of various sizes covering a range from hundreds of microns to a few millimeters. For low values of sand mass, the plate resonance decreases and eventually reaches a minimum. In this regime, there is no dependence on particle size. After the minimum, the frequency increases with additional mass. In this regime, a particle size effect is observed. Numerical models based on a two-layer continuum system are explored to describe the response of this system. Elastic and bending moduli for the layer representing the granular material are found by iteration such that they match the measured frequencies. An “effective bending stiffness” of the granular layer is found that depends on particle size. The results are expected to impact quantitative aspects of mine detection by acoustic means. [Work supported by ARL]

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