 ICCES, vol.19, no.1, pp.25-25

The study of using external fluid loading on a vibrating rectangular plate for suspended sediment concentration in water

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Summary

This paper presents the result of a theoretical study on a new fluid density measuring concept which uses the effect of external fluid loading on a vibrating thin plate. The underling physical principle of this concept is that the resonance frequencies of an immersed vibrating plate change with the surface impedance changes caused by the mass density variations of the external fluid. In this paper, the analytical solutions of resonance frequencies with specific gravity are demonstrated by using the finite element simulation, COMSOL. The theoretical analysis presented in this paper shows that the resonance frequencies of an immersed vibrating thin plate affect significantly with surrounding fluid loading, which is loaded as an extra added mass. The resonance frequencies shifted to lower frequencies when the fluid specific gravity increased. For the resonance frequency ratio applied to the specific gravity estimation of onsite measurement, the increases in this coefficient are directly proportional to the increase with the specific gravity. In addition, size effect on the thin plate is also presented. The results show that the thickness of the thin plate is the most important factor for this resonance frequency ratio. Based on the theoretical analysis in this paper, using the loading by the external fluid on the vibrating thin plate is feasible.