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Numerical Analysis of Cylindrical Structure VIV Response by Discrete Vertex Method

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Summary: A quasi 3 dimensional VIV response analysis method which combined 2 dimensional hydrodynamic force simulation by discrete vortex method with 3 dimensional finite element method has been proposed. Use of discrete vortex method and its limitation have been shown. Usefulness and characteristics of the quasi-3D VIV response analysis method have been investigated. The most important thing of 3D VIV response analysis with a strip theory is hydrodynamic correlation length of a riser axis direction. If correlation between strips of the hydrodynamic force shows a result completely different from real phenomena, it is difficulty that a strip theory applies to 3D VIV response analysis. Generally, the phase of hydrodynamic force acting on each strip obtained by the method is random, because hydrodynamic force is simulated at each strip independently. Actually, the hydrodynamic coefficient of lift force on a fixed circular cylinder is different from the average of the hydrodynamic coefficients of lift force on each strip.However, the phase of hydrodynamic force on each strip align at the resonant frequency that the natural frequency of a circular cylinder becomes equal to the frequency of vortex separation. In a VIV response matter, a simulation of hydrodynamic force on a circular cylinder by a strip theory is valid under the resonance condition of a natural frequency and vortex separation. The quasi-3D VIV response analysis method enables 3D VIV analysis with a less computation load. It is clear that the quasi-3D VIV response analysis method is useful at only a resonance condition, but it is enough in engineering, because the biggest VIV response takes place at a resonance condition.

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