



## ***Experimental study of WIV of uniform cylinders in tandem arrangement***

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### ***Abstract***

*In many practical situations, the cylinders are found in a specific arrangement and have different transverse vibration response from isolated cylinders. In the most simplified case one can consider two rigid circular cylinders with the same diameter in tandem arrangement. In this simple configuration the upstream cylinder is fixed and the downstream cylinder is flexibly mounted. In the present study the cross flow and inline vibration amplitudes of two uniform circular cylinders in tandem arrangement are presented. The single degree of freedom vibrating system (i.e. the downstream cylinder either in transverse or stream-wise directions) has a low mass-damping parameter ( $m^*\xi \approx 0.0402$ ). The Reynolds number ranges from 2,800 to 28,000 and the reduced velocities vary from 1 to 21. Various separations ( $S/D$ ) from 2 to 5 are studied. The trailing cylinder oscillation at  $S/D=3,4$  presents what previous researchers have termed interference galloping behavior. These initial results validate the experimental set-up and lead the way for future work.*

### ***Introduction***

*Most of the previous studies on vortex induced vibration phenomena have been concentrated on the understanding of vortex patterns in the wake of single uniform cylinders and their inline and crossflow vibrations. In many practical situations, the cylinders are found in arrays and have different transverse vibration response from isolated cylinders. Some typical examples are multi arrangement of several (production or drilling) risers of a floating platform with each other (or with some other cylindrical structures) or the array of the cylinders in a crossflow heat exchanger that can undergo wake induced vibration phenomena. Today with better knowledge about the Vortex Induced Vibration (VIV) phenomena of single cylinders, researchers are trying to understand different aspects of the flow field around the array of the cylinders.*

*In the most simplified case of multiple cylinders arrays, one can consider two rigid circular cylinders with the same diameter in tandem arrangement (i.e. one cylinder is aligned behind the other in a way that the line of the centers is parallel to free stream). In this simple configuration the upstream cylinder is fixed and the downstream cylinder is flexibly mounted. In the above arrangement the limited independent variables are the diameter of the cylinder, mass and damping of the vibrating system, center to center spacing of the cylinders and the free stream velocity.*

*Not so many of the experiments about the Wake Induced Vibration (WIV) phenomena in the literature are limited to the above simplified configuration of tandem cylinders. Bokaian and Geoola [1] studied two circular cylinders in tandem arrangement. The Reynolds number varied from 700 to 2000 and the oscillating cylinder mass parameter ( $m^*$ ) was 8. The center to center*