# Flow-induced vibrations of an elastically sphere at low mass-damping

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An experimental apparatus for the study of the forces and body responses associated with vortex-induced vibrations (VIV) of an elastically mounted sphere has been constructed.
Vortex-induced vibration of structures is of practical interest in many fields of engineering and becomes relevant to design civil and hydraulic structures, marine and land vehicles, as well as it can cause large-amplitude vibrations of tethered structures in the ocean.
The experimental apparatus is constituted by a sphere, solid to the bottom of water channel through an elastic cylindrical support and constrained to vibrate in the main direction of the flow and transversely (Figure 1).

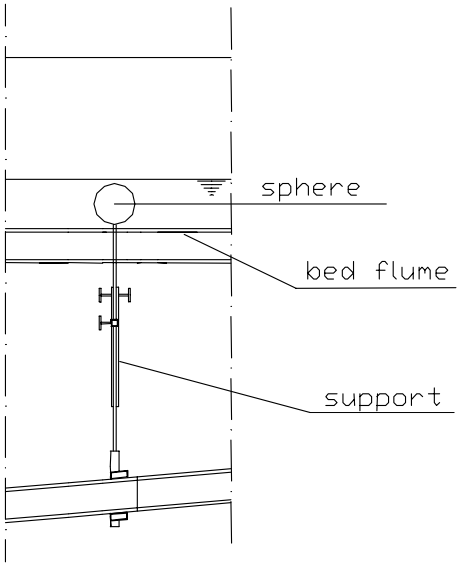


Figure 1. The experimental apparatus.

Several design criteria have been established for the apparatus, as follows: 1) extremely linear system dynamic; 2) low mass ratio, m* (system mass)/(displaced fluid mass); 3) low damping ratio, $\xi$, (damping)/(critical damping); 4) instantaneous and direct measurement of force and displacements ; 5) possibility to change the natural frequency of the sphere fixing different constrain conditions for the support.
The displacements have been measured using a set of position transducers while the flow field around the body has been measured through the laser Doppler anemometer.
The aim of this work is to address the research to the study and analysis of structures with different body shape, not only cylindrical, which have received surprisingly little attention while the recent works such that of Fujarra et al. (1998), Saltara et al. (1998),

Pesce & Fujarra(1999), Atsavapranee et al. (1998), Balasubramanian & Skop (1996) and Khalak & Williamson (2000) mainly focus on the study of flow-induced vibration of cylinders.
In particular the experiments have been addressed to the analysis of “behaviours” of sphere and flow field around the sphere itself, in presence of resonance and “lock-in” phenomena.
At the moment, through the spectral analysis of the sphere oscillation amplitudes, the research focus on the aspects related to conditions in which the range of response frequencies is close to the natural frequency of the body. This research has been developed changing the values of flow velocity, flow depth on sphere and natural frequencies of body.
The relation among dimensionaless parameters, characteristic of the flow and related to the geometrical features of the system, typical of such phenomena and defined for the sphere have been derived in order to describe the process and compare the results with those obtained for the cylindrical structures.
Finally the attention has been focused on the flow field investigated through the spectral analysis of the velocities measured downstream the body.