Graduation Project

Afstudeerrichting: Structural Mechanics / Offshore Engineering

Phenomenological Modelling of Vortex-Induced Vibrations of Marine Risers

Introduction

Production of oil and gas at sea requires risers to transport these hydrocarbons upward from wells at the seafloor to a platform at sealevel. Risers are tubular pipes with a diameter in the order of 20 inch and a length ranging from several dozens of meters up to more than 2 km, depending on the waterdepth. In deep waters, floating platforms are used and the risers cannot be clamped to a platform support. Therefore, they can vibrate freely under the influence of platform motions, wave action and sea currents. Knowledge about these vibrations is important to determine the fatigue life of a riser.

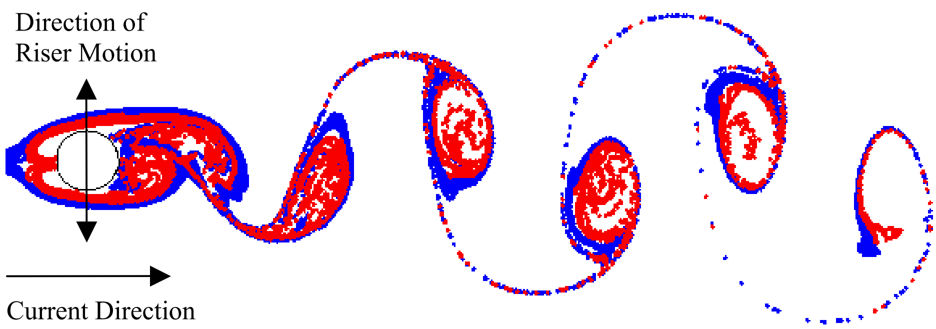
Vortex-Induced Vibrations

This graduation project will focus on the riser motions induced by vortex shedding due to the presence of a current. When a vertical cylinder is placed in a flow, the flow will separate and vortices will be formed in the wake behind the cylinder. The alternate shedding of these vortices results in a time-depent lift force on the cylinder (or riser). This lift force is dependent on a multitude of factors, such as riser diameter, current velocity, turbulence, roughness of the riser surface, motions of the riser due to movement of the platform, etc. Since these quantities are not constant along the length of the riser, the lift-force is not only time-, but also position-dependent.

Phenomenological Modelling

Nowadays, Computational Fluid Dynamics (CFD) codes are capable of simulating vortex shedding around segments of cylinders at relatively high Reynolds number. It is however not yet (if ever) possible to simulate vortex shedding around entire risers under sea conditions. Therefore, so-called phenomenological models are used that describe the nature of a loading on a macroscopic scale without accounting for the micro- or mesoscopic origin of the loading. Phenomenological models which are used to investigate vortex-induced vibrations consist of a nonlinear oscillator-equation (to model the lift force) that is coupled to the equations of motion of the riser.

The **aim** of this graduation study is to modify existing phenomenological models in order to minimize the gap between measurements and theoretical predictions.



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