# Numerical Simulation for Identification of Free Spans in Submarine Pipelines

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## ABSTRACT

It is well known that, after a submarine pipeline is laid over the seabed, free spans may appear due to the unevenness of the seafloor, associated to the relatively high bending stiffness of the pipe, and to the residual tension from the pipe laying process.

The identification of free spans along a given pipeline route is very important due to several factors. One of them is to allow the verification of design criteria related to fatigue induced by vortex induced vibrations (VIV), such as those presented on the DNV-RP-F105 code [1]. Also, the number and length of free spans on a route may require extensive intervention works (e.g. rock dumping, digging, etc) to mitigate the spans and reduce unacceptable span lengths; or, alternatively, may require changes in the predetermined route of the pipeline.

In this context, a numerical tool has been developed for the determination of the final equilibrium configuration of a pipeline after the execution of its laying procedure [2, 3]. The tool is based on global Finite Element models, and simulates the evolution of the pipe laying process along a predetermined route, using the actual seabottom bathymetry data. The objective is to allow an easier implementation of the verification of VIV induced fatigue, and the assessment of a given route in terms of the number and length of its free spans; for this purpose the tool may be associated to a program oriented towards the synthesis and optimization of submarine pipelines.

In this work, a case study is presented to illustrate the use of the tool. In this case, a route is proposed to connect the pipeline from one location to another over the seabottom, represented by a complex bathymetry of the soil and by its physical properties.

## REFERENCES

[1] DNV-RP-F105, “Free Spanning Pipelines”, Recommended Practice, Det Norske Veritas, February 2006.

[2] JACOVAZZO, B. M., “Numerical Tools for the Analysis of Offshore Pipe Laying Operations”, DSc Thesis (in portuguese), COPPE/UFRJ – Civil Engineering Department, Rio de Janeiro, 2012.

[3] JACOVAZZO, B. M., JACOB, B. P., “Numerical Tool for Automatic Identification of Free Spans on Submarine Pipelines”, Proceedings of 32nd OMAE 2013, Nantes, France.