NTNU Trondheim
Norwegian University of Science and Technology
Faculty of Engineering Science and Technology
Department of MarineTechnology

MASTER THESIS IN MARINE TECHNOLOGY

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FOR

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Octabuoy concept and Spar Buoys: non linear effects and analysis

(Octabuoy konseptet: ikke-lineære bølgelaster og viskøse effekter)

The Octabuoy is a semisubmersible drilling and production platform specially shaped to improve the behavior in harsh conditions, as in North Sea, relative to to other deep draught floaters (semis and spars). The design consists of an octagonal ring pontoon supporting four columns, with limited waterplane area, and the topside facility. A set of risers is used for pumping the oil and a mooring system takes care of the configuration and horizontal motion control. This concept represents an alternative floating production system to spars, tension leg platforms and traditional semisubmersibles, especially for deep and ultra-deep water oil explorations. The dynamic response of the platform depends on its coupling with the risers and mooring lines. The latter is expected to be increasingly significant going toward deeper waters. The platform should be able to withstand the nonlinear-wave loads in extreme sea conditions and the viscous effects due to interaction with current, wind and waves. In this framework it is crucial to identify prediction tools able to handle the relevant phenomena and to provide reliable predictions in feasible time. This is especially true when dealing with statistical analyses.

Objective

The aim of the thesis is to improve the knowledge about the Octabuoy concept with focus on quantifying the relevance of nonlinear-wave loads and viscous effects in operational conditions. Existing simulation tools based on potential-flow theory and real viscous-flow conditions will be examined and applied in a comparative and combined way to estimate the loads. Existing experimental studies on Spar Buoys will be used to assess the developed solution strategy for the loads prediction.

The work should be carried out in steps as follows:

1. Give an overview of previous work, with main focus on state-of-the-art solvers used to estimate the nonlinear effects. Topics that have been discussed in the project thesis need not to be repeated in the master thesis report unless found useful for the discussion.
2. Compare different alternative methods for the estimate of the loads and identify a suitable numerical-solution strategy able to estimate nonlinear effects for a deep floating platform as an Octabuoy or a Spar Buoy and then to analyse its response.
3. Use existing experiments on Spar Buoys to assess the use of the identified solution strategy in terms loads/motions. Examine the numerical convergence and accuracy of the involved solvers.

4. Apply the solution strategy to the Octabuoy concept using also what has been learnt from the project thesis and examine the relative importance of nonlinear effects on the response.

The work may show to be more extensive than anticipated. Some topics may therefore be left out after discussion with the supervisor without any negative influence on the grading.

The candidate should in her report give a personal contribution to the solution of the problem formulated in this text. All assumptions and conclusions must be supported by mathematical models and/or references to physical effects in a logical manner.

The candidate should apply all available sources to find relevant literature and information on the actual problem.

The thesis should be organised in a rational manner to give a clear presentation of the work in terms of exposition of results, assessments, and conclusions. It is important that the text is well written and that tables and figures are used to support the verbal presentation. The thesis should be complete, but still as short as possible. In particular, the text should be brief and to the point, with a clear language. Telegraphic language should be avoided.

The thesis must contain the following elements: the text defining the scope (i.e. this text), preface (outlining project-work steps and acknowledgements), abstract (providing the summary), table of contents, main body of thesis, conclusions with recommendations for further work, list of symbols and acronyms, references and (optional) appendices. All figures, tables and equations shall be numerated.

The supervisor may require that the candidate, in an early stage of the work, present a written plan for the completion of the work. The plan should include budget for the use of computer and laboratory resources that will be charged to the department. Overruns shall be reported to the supervisor.

From the thesis it should be possible to identify the work carried out by the candidate and what has been found in the available literature. It is important to give references to the original source for theories and experimental results.

The thesis shall be submitted in two copies:
- The copies must be signed by the candidate.
- This text, defining the scope, must be included.
- The report must appear in a bound volume or a binder.
- Drawings and/or computer prints that cannot be included in the main volume should be organised in a separate folder.
- The bound volume shall be accompanied by a CD or DVD containing the written thesis in World or PDF format. In case computer programs have been made as part of the thesis work, the source codes shall be included. In case of experimental work, the experimental results shall be included in a suitable electronic format.

Supervisor :Marilena Greco
Submitted :16 January 2012
Deadline :15 June 2012

Marilena Greco
Supervisor