

Numerical Simulation of Ice Loads on Gravity-Based Concrete Structures of “Sakhalin-I” And “Sakhalin-II” Projects

Alexander T. Bekker, Olga A. Sabodash, Aleksey Yu. Kochev
Far Eastern National Technical University
Vladivostok, Russia

ABSTRACT

In the study, the problems of a statistical modeling of ice loads from drifting hummocky features and level ice fields on the reinforced gravity based structures in Piltun-Astohsky and Lunsky fields offshore Sakhalin are investigated. The authors made a comparative analysis of ice loads on various types of gravity based structures in conditions of the Sea of Okhotsk according to the standards, procedures and guidelines from various codes of design. And also the probabilistic model of ice loads, developed by the authors in the previous studies, was considered for comparative analysis.

KEYWORDS: offshore gravity-based platform, ice loads, ice fields, ice hummocks, codes, standards, comparison.

INTRODUCTION

Practical realization of oil and gas projects in the Far East has started with "Sakhalin I" and "Sakhalin II" Projects under which four reinforced-concrete gravity producing platforms, like "Orlan" ("Sakhalin I"), "Piltun-Astohsky-A" (PA-A or "Molikpaq"), "Piltun-Astohsky-B" (PA-B) and "Lunsky-A" (LUN-A) ("Sakhalin II") were built on 30-50 m depths. Nevertheless, to provide reliability, safety and to decrease risk of operation of similar structures remain a problem till now.

Durability and reliability of the ice-resistant structures depends on validity of calculation of the ice loads from ice features of a various age and nature (such as drifting level ice fields, the hummocky and rafting fields, separate hummocks of large size, grounded hummocks, etc.). Thereupon the problem of comprehensive study of ice impacts and development of methods of calculation of ice loads on the offshore hydroengineering structures remains urgent in world practice for more than one decade.

The existing design codes from USA and Canada (API, 1995; CSA,

2004; ISO, 2007), and also some other countries, are grounded on experience of design and exploitation of fixed platforms for environmental conditions of Cook Inlet, the Beaufort Sea and Bohai Bay, where platforms of pile type and gravity-based concrete structures were applied. The Russian standards (SNiP, 1989; VSN, 1988) also do not take into account the overall specificity of ice conditions offshore Sakhalin, in particular, in estimation of ice loads from hummocks and in calculations of dynamic ice loads.

Thus, the purpose of this study is to make a comparative analysis of ice loads from drifting level ice fields and hummocky features on different types of ice-resistant gravity-based structures on an offshore of the Sea of Okhotsk according to the procedures and the guidelines of existing codes of design, and to the probabilistic model of the authors, as well.

TASKING

Aspects of standardization of parameters of an ice cover are especially actual in connection with a problem of operational reliability of marine oil-and-gas production structures. Thus a main problem is to obtain sufficient volume of the solid data showing specificity of spatial-temporal variability of the ice cover parameters in the sea areas of the production fields directly.

The problem of an estimation of ice loads on structures has appeared in 60's in connection with studies of interaction between the river ice and various hydroengineering structures (Korzavin, 1962), as well as with designing of lighthouses in the Gulf of Bothnia (Maattanen, 1981). In this connection codes of design were developed for such structures where many factors influencing ice loads during interaction between ice and the structure were estimated more seriously. Originally, the base of offshore structure calculation has included the concept of limiting conditions applied till the present time in all the codes practically.

As of today, the worldwide practice doesn't have a unified approach to