

## **Simulation of Impact of Steady Ice Features Forming Extreme Ice Loads on Engineering Objects Offshore Zone**

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### **ABSTRACT**

The study is devoted to the problems of mathematical simulation of the physical process of interaction between the ice cover and the offshore engineering objects in terms of simulation and statistical methods. In the previous studies the authors made an attempt to describe a wider scope of possible scenarios of interaction which might cause an ice force extreme by value. The purpose of this study is to simulate effects of stable ice congestions which caused extreme ice loads on structures.

**KEY WORDS:** marine ice-resistant platforms (MIRP), an extreme ice load, probabilistic characteristics, a simulation model.

### **INTRODUCTION**

When designing the structures intended for operation in the seas under severe ice conditions, it is necessary to consider a possible effect from the drifting ice features, such as level ice fields, layered or hummocky ice fields, individual hummocks, ridges of hummocks, grounded hummocks, icebergs, ice masses from icing-up, combinations thereof, etc.

The offshore platforms are mostly affected by the drifting ice features (such as individual hummocks, ridges of hummocks, or giant level ice fields, as well), loads from which may be very high and become extreme for the platforms.

The subject was considered urgent because the effect from the extreme ice features was one of the most difficult challenges to include during MIRP designing. From analysis of the worldwide investigations of ice effects on marine hydroengineering structures, as well as from the guidelines of the normative documents, it became clear that they had omitted a considerable portion of the calculated occurrences and kinds of effects which could occur in the open marine area. In addition, the analysis of references in the practice of ice load calculations showed that various researchers had considered basically the particular cases of the structure supports affected by any ice feature (such as the

level/hummocky ice fields, grounded hummocks, icebergs, etc.) only. Thus a significant difference is observed in the assessment of the ice loads values made by different researchers.

The least studied is the problem of an assessment of the extreme ice loads from drifting hummocks and hummocky fields, as well as giant level ice fields that may become a real threat for the marine ice-resistant structures operation.

Many studies were devoted to investigations of the interactions between drifting hummocks and structures. Especially full fracture of a hummock was considered in detail, as well as its stop before a support after small cutting. However the majority of researchers did not consider the fact that the solid ice feature (which has stopped before a structure) may collect sufficiently large loads from the surrounding level ice and pass them to the support.

Thus the major problem is made in connection with the massive hummocky field, when the hummock had stopped and the load from the fractured thinner drifting ice had passed to it. In this case the extreme ice load on the structure was determined by wind/current forces on the ice feature approaching the support, and the moving forces from the drifting ice supporting such ice feature. Thus two versions of further development of events were possible:

- If the load from an ambient level ice field is great enough, there will be cutting of a hummock by a structure;
- If the load from an ambient level ice field is insufficiently great (i.e. ambient ice is weaker than the hummock which has stopped before a structure), the processes of ridging and creation of new hummocks will occur behind the hummock.

Thus, creation of extreme ice loads on marine ice-resistant structures was considered from the point of view of analysis of possible implementation of various calculated situations with the ice that may occur because of interaction between an ice cover and a structure.

The purpose of the study is to develop a procedure of definition of probabilistic characteristics of extreme ice loads on the offshore marine