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The Registration of Temperature during Calculation of the Ice Abrasion

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ABSTRACT

The problem of definition of platform concrete leg abrasion value at the variable level becomes more and more actual in connection with the shelf development in the arctic seas. However this problem is studied insufficiently that is confirmed by lack of certain guidelines in the norms of design.

Investigations showed (Saeki H. et al, 1987), (Itoh Y. et al, 1995), (Itoh Y. et al, 1994) that the main factors influencing the concrete abrasion are as follows: the rate of pressure on ice contact with a structure, a way of interaction (abrasion) between a structure and an ice field in the contact zone, strength and temperature of ice, resistance of concrete and its ingredients to the abrasion. In practice, it is necessary to study local ice conditions carefully in order to calculate the depth of ice abrasion of marine concrete structures. The ice temperature is very important as it determines the ice mechanical properties substantially.

When choosing a zone on the structures subject to abrading effect from ice formations in the certain area, it is necessary to take into account the most relevant factors, as follows: sea level fluctuation; variability of depth of the drifting ice formations; the mechanism of ice-formation collapse on contact with marine engineering structures.

In the paper, the procedure of definition of the ice design temperature for calculation of the ice abrasion value. From the outcomes of the calculations it is possible to reveal the most unfavorable directions of ice cover impact and to determine the most abraded areas of a structure in the variable level zone, as well as to provide guidelines on an icebelt design with local reinforcements of the structure.

KEY WORDS: abrasion, ice temperature, ice strength, sleet-proof platform, simulation model .

INTRODUCTION

When designing the concrete structures operated in seas with highly dynamical ice cover, it is necessary to pay major attention to the concrete wear resistance against ice abrasion. The ice abrasion causes loss of effective thickness and strength of structural components which should resist major ice loads. The ice abrasion of structural components is often observed in the concrete/reinforced-concrete structures like the bridge buttresses, the lighthouses in Botnichesky Bay and in the Beaufort Sea and offshore facilities, as well.

High dynamism of an ice cover, its major cohesion and significant strength stipulate increased requirements to selection of the concrete mix for the marine platforms (MSPP), and the problem of definition of the MSPP concrete leg abrasion value in the variable level zone becomes especially important. This problem is important today because the physical process of ice crushing (when ice impacts the offshore structures) is complicated and studied insufficiently, the number of experiments on ice load measurements (specially full-scale experiments) and on the depths of the structure material abrasion is rather small.

From the experience of MSPP design in the Sea of Okhotsk it is known, that the norms of design in force do not allow determining the value of MSPP concrete leg abrasion by the ice cover. That is why there are no actual requirements to concrete under conditions of the intensive ice cover local impact. As a result, the offshore oil and gas production platforms for Lunsky and Piltun-Astohsky fields have been provided with the special ice-resistant belts in the ice load zones. Their main function is to protect the concrete from the ice cover abrasion.

STATEMENT OF THE PROBLEM

From the investigations it is established (Saeki et al, 1987), (Itoh et al, 1995), (Itoh et al, 1994) that the main factors influencing the ice abrasion of concrete are as follows: intensity of pressure during "ice-structure" contact, a path of interaction (abrasion) between a facility and an ice cover in a contact zone, ice strength and temperature, sea level fluctuation, resistance of concrete and its ingredients to abrasion. In practice, it is necessary to study local ice conditions carefully in order to calculate the depth of ice abrasion of marine concrete structures. The ice temperature is very important as it determines the ice mechanical properties substantially. The ice cover temperature depends on temperatures of air, depth of snow on ice, and seawater.

According to (SNiP 2, 1995) loads from ice cover on hydroengineering structures should be determined on the basis of statistical data on physical-mechanical properties of ice, hydrometeorological and ice conditions around facility within the time period of the greatest ice