

Zeitschrift: IABSE congress report = Rapport du congrès AIPC = IVBH
Kongressbericht

Band: 14 (1992)

Artikel: Abrasion of concrete structures by ice

Autor: Huovinen, Seppo

DOI: <https://doi.org/10.5169/seals-853162>

Nutzungsbedingungen

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. [Siehe Rechtliche Hinweise.](#)

Conditions d'utilisation

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. [Voir Informations légales.](#)

Terms of use

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. [See Legal notice.](#)

Download PDF: 08.02.2025

ETH-Bibliothek Zürich, E-Periodica, <https://www.e-periodica.ch>



Abrasion of Concrete Structures by Ice

Usure par la glace de structures en béton

Widerstand von Beton gegen Abrasion durch Eis

Seppo HUOVINEN

Dr.
Techn. Res. Centre of Finland
Helsinki, Finland

1 INTRODUCTION

In arctic sea regions a concrete sea structure is subjected to heavy mechanical loads near the water level due to the moving ice sheet. Moving ice sheets load protruding aggregate stones, and the loads are considerably greater than the compressive strength of ice as determined in uniaxial compressive tests. This is due to the triaxial compression stress in the ice surrounding the stone surface.

Also, recurrent freeze-thaw cycles in the concrete wetted by waves and the tide expose the concrete to damage if it has not been designed to resist recurrent freezing in marine conditions. Temperature changes that exceed the approximate value $\Delta T = 40\text{ }^{\circ}\text{C}$ also deteriorate the bond between the cement stone and the stones and increase cracking in the cement stone between the aggregate stones.

This paper deals with the abrasion problem. The abrasion depth and resistance of concrete in arctic sea conditions can in practice be determined by calculations and laboratory tests.

2 ABRASION STUDIES

In a Finnish study the determination of abrasion of concrete in arctic offshore structures was based on four different methods:

- laboratory tests
- tests with an icebreaker
- abrasion studies on Finnish lighthouses
- computer calculations.

An abrasion machine was developed for laboratory use. The abrasion resistance of different concretes can be studied with the abrasion machine so that the concrete will have undergone cyclic freezing-thawing tests before the abrasion tests.

The abrasion resistance of similar concrete mixes was also studied at sea with an icebreaker. In icebreaker tests the specimens were fastened onto the bow of the

icebreaker at water level. The abrasion of the concrete specimens was measured at the end of the tests.

The abrasion of Finnish lighthouses was measured at four lighthouses in the Gulf of Bothnia.

The abrasion and fracture of the concrete were also studied with computer calculations. The ice pressures against small areas such as aggregate particles that are protruding from the surface of a concrete structure were measured with laboratory tests. Also the bond strength between aggregate particles and cement stone was measured in tests. These values were needed in the computer calculations. On the basis of the calculations, using the calculation model, the abrasion of concrete was estimated as the function of ice sheet movement.

3 COMPARISON OF TEST RESULTS AND COMPUTER CALCULATIONS

In Fig. 1 a comparison of the abrasion (max. and min. values) of concrete is presented as the function of the compressive strength of concrete in laboratory abrasion tests during 10 minutes, in icebreaker tests, for ice field movements of 40 km, 100 km and 1000 km according to the abrasion calculations and in Finnish lighthouses during one year.

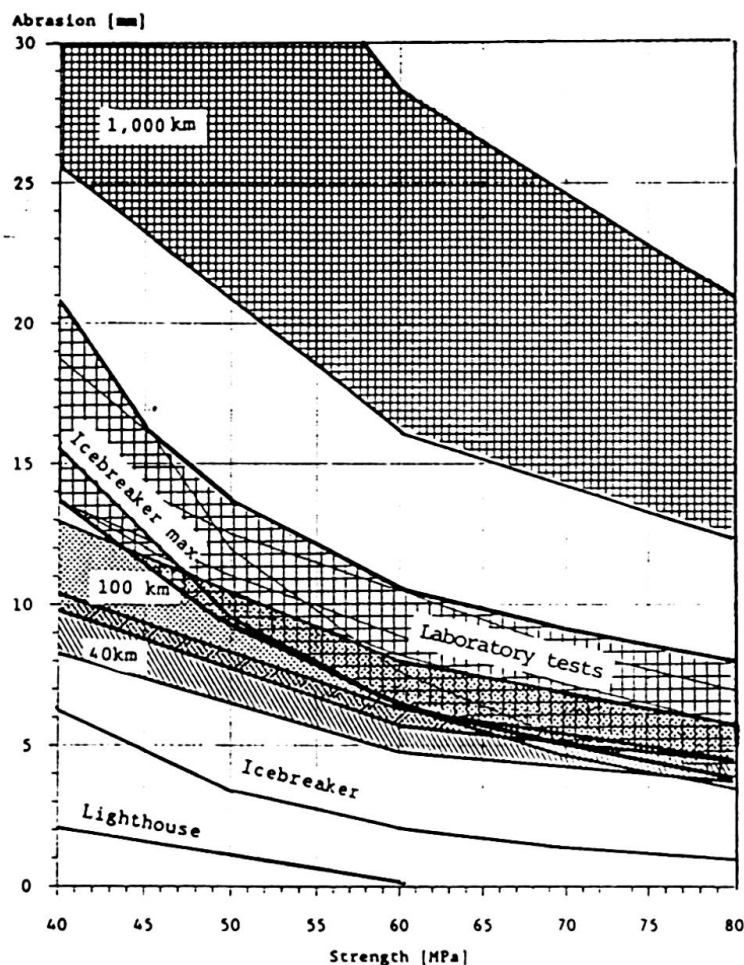


Fig. 1. Abrasion of concrete as the function of compressive strength.

Leere Seite
Blank page
Page vide