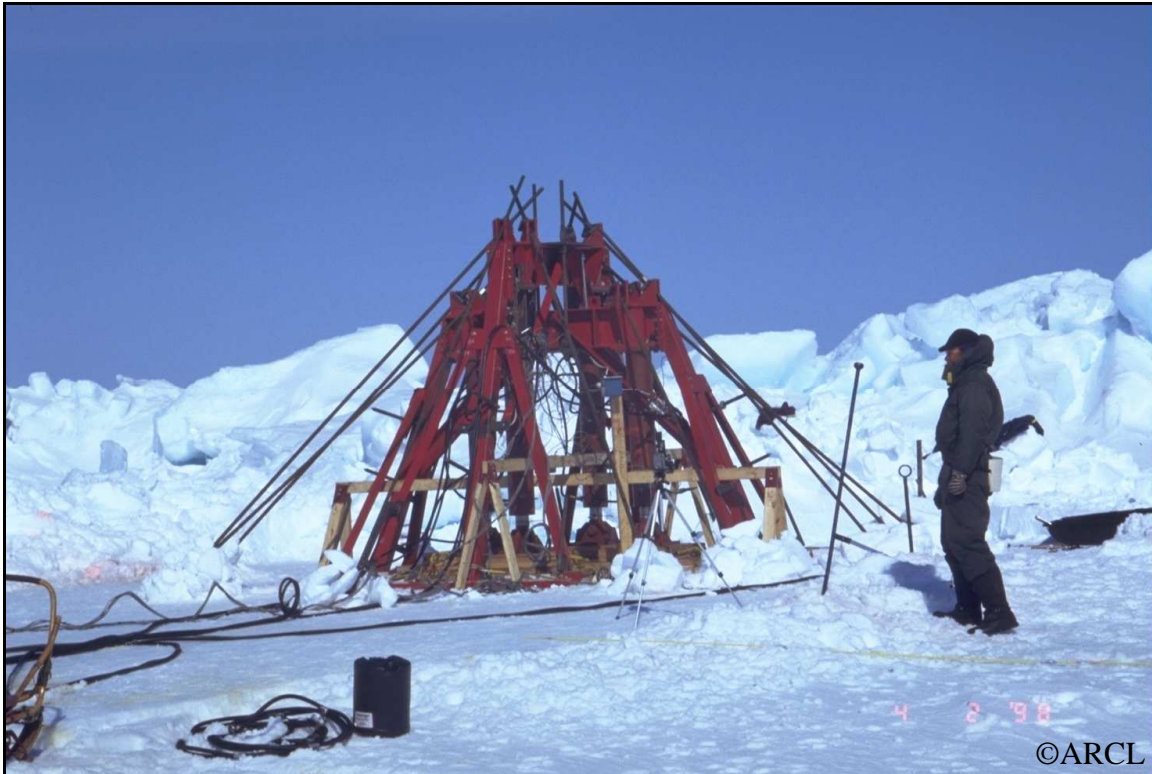


Sakhalin Island Measurement of Full Scale Properties of First Year Ridges 1997 and 1998

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In recent years, there has been interest in construction of offshore drilling platforms and bridges such as the Prince Edward Island Fixed Link in offshore areas which are subject to extensive first year ice during the winter. Unlike the high arctic, for which the structure design is dominated by very thick multi-year ice features, in areas farther south where only seasonal first year ice exists, these features do not exist, rather larger first year ice ridges are the dominated design ice feature.

Very little is known about the strength properties of first year ridges. The ridges are formed as the level sea ice is compressed by the action of the wind and current. Large piles of floating ice are created which are called ridges. As the ice pile refreezes, a thick solid layer forms at the surface which is underlayed by large blocks which are partially frozen together. There is very little known about the strength properties of this partially refrozen ice mass in the ridge keel.

The objective of this research project was to develop a technique to measure the properties of the ridge keel in full scale. Several methods have been investigated and tested at model scale.

The technique selected to develop for this project is called the “Punch Shear Test”. This method involves cutting a square of about 2.5m per side through the refrozen layer in order to free the block from the surrounding ice. A loading frame is then placed over top of the block and anchored to the surrounding ice sheet. Hydraulic rams attached to the loading frame are then used to push the surface ice block down into the keel. This generates a punch shear failure in the keel with a failure plane going from the surface to the bottom of the keel. The first version of the equipment used in the 1997 was capable of applying 100tons and in 1998, a new frame was designed which was capable of 200 tons of vertical force.

In order to carry out this project, a number of unique items needed to be developed. In the Sakhalin Island area, the refrozen layer ranges from 1m to 3 m thick. In order to cut through this thickness of ice, new cutting equipment was developed. Due to the very high vertical loads being applied to the ice sheet, a new system for anchoring the loading frame to the ice was required. Ice screws which are (500mm) in diameter and 1.4m long and capable of reacting 25tons were designed and built.