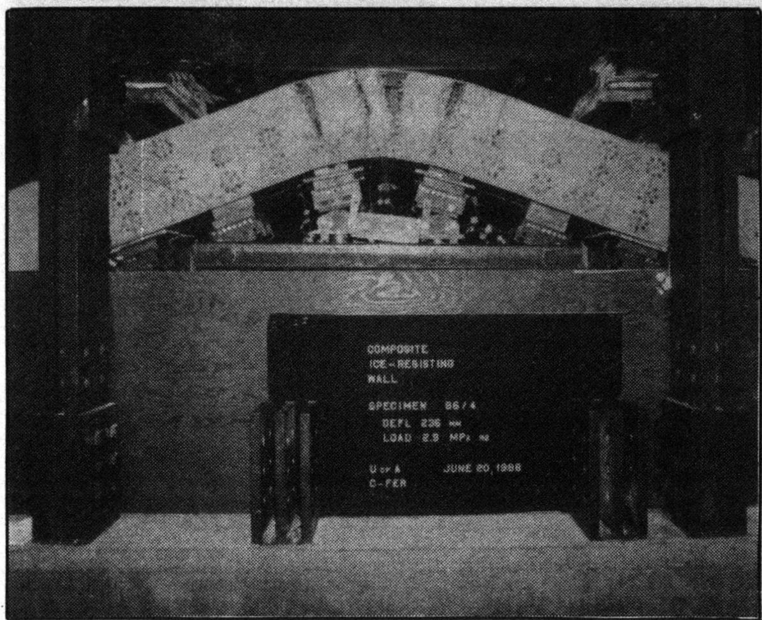
U of A pioneers ice wall protection

by Greg Halinda

The Beaufort Sea, a cold, shallow expanse of water on the north shore of the Yukon and Northwest Territories, holds one of Canada's most promising oil and gas reserves.

Petroleum exploration on the Canadian shelf of the Beaufort has only been going on since 1976. To facilitate exploration and production, some new ideas in oil rig engineering have evolved.

To keep an oil rig in the Beaufort Sea for an extended time, adequate protection from natural conditions like extremely low temperatures, seawater corrosion, and constantly-moving ice surfaces must be afforded.



Though this beam is cracked it has not yet failed.

Researchers at the U of A are involved in this relatively young field, and one of them has just completed his doctoral thesis on a new wall designed to protect oil rigs from ice on the Beaufort.

Brendan O'Flynn is from the department of Civil Engineering at the U of A. He has completed three years of research on what is called a composite ice-resisting wall.

The wall is a simple-looking sandwich of concrete and steel that surrounds the oil rig at sea. Its purpose is to resist pack ice until the ice breaks up or moves off to the side of the structure.

Pack ice varies in thickness from eight to 12 feet. It is constantly in motion due to winds and tides, and exerts tremendous forces on stationary oil rigs.

The composite wall absorbs and redirects these forces.

The simple design of the wall (poured concrete between two steel plates) has a story behind it.

"The wall is effective for high loads because a regular reinforced concrete wall in a rig would be very congested with reinforcing bars," said O'Flynn.

This translates into large amounts of (expensive) steel. O'Flynn's use of concrete between two parallel steel plates (held together with steel rods called shear connectors) was an economical move.

O'Flynn had to find the right combination of length (span) versus depth to ensure the most cost- and load-efficient design.

His efforts involved testing 17 different scale sections of wall, or "beams".

A beam would be braced on a test stand in the lab and a gradually-increasing force applied to it. Behaviour of the "wall" was recorded as its concrete began to crack and until the wall failed.

Incidentally, the test beams all performed well long after concrete cracks showed. The cracks only indicate how the wall is "carrying" the load. In an actual wall in service, the concrete within would be expected to crack.

The ice wall is a relatively "deep" structure (span/depth ratio of about five). O'Flynn says this must be taken into consideration.

"There is a big difference from a structural engineering viewpoint for shallow vs. deep sections," he said.

O'Flynn did his lab work alongside personnel from the U of A's Centre for Frontier Engineering Research (CFER), who were load-testing their own variant of a composite wall.

O'Flynn said between 40 and 50 thousand dollars of federal research grants went into the two composite wall projects. His did not rely on funding from the oil industry, and CFER's did.

Though O'Flynn's project is completed, the design of the composite ice wall is undergoing refinements to make it more efficient. "If they had to build tomorrow we could do it," said O'Flynn.

In light of the oil slump that is leading to the mothballing of current exploration, such demand is unlikely. But O'Flynn adds, "If and when they decide to go, the technology has to be available."

Engineers in other countries like Japan and England have also been working on composite walls, and are planning to come together for a workshop on this still-developing science. O'Flynn is looking for a summer 1987 rendezvous.

"It is still in its infancy," he said.

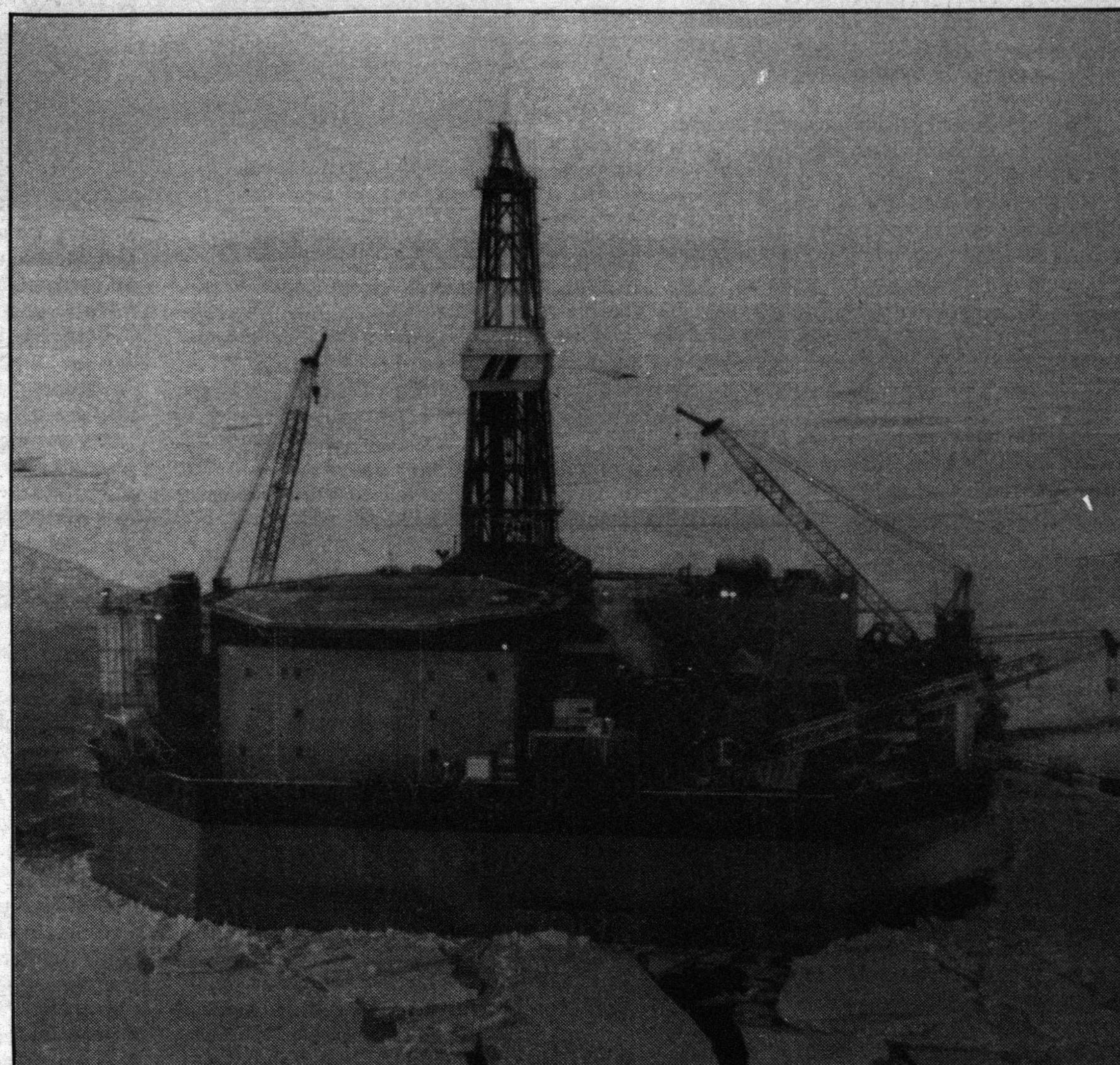


Photo courtesy of Gulf Canada Resources Inc.

The need for ice protection is evident in this photo of Gulf's Molikpaq drilling rig.