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Beginnings at Baie Comeau, Quebec

The Jarlan breakwater was first constructed in 1962 at Baie Comeau, Quebec, by the Federal Department of Public Works. Since then, perforated breakwaters have been built at Chandler Harbour (1970), Quebec and Roscoff Harbour (1972), in France, all of which have been successful. Their design, which prevents all waves, except those of exceptional size, from pouring over the top of the breakwater, makes it possible to use the opposite side of the structure as a wharf and a quiet harbour for ships.

Since the North Sea is one of the world's roughest, the Phillips Norway Group called for tenders for a storage tank that could endure the high seas and allow oil production to continue even when the regular loading of tankers was interrupted.

Mr. Jarlan and the French company C.G. Doris (Compagnie Générale pour les Développements opérationnels des Richesses sous-marines), submitted designs and quotes to the Phillips Norway Group. Mr. Jarlan acts as consulting engineer for C.G. Doris, which is sub-licencee of Protocean Limited, a Canadian company set up by Mr. Jarlan. The company and Mr. Jarlan hold the original licence from Canadian Patents and Development Limited.

The contract was awarded to Doris in July 1971, and construction began in the autumn of 1971, in Stavanger, Norway, 200 miles from the Ekofisk drilling site.

Principle of Jarlan breakwater

The perforated outside wall of the storage tank allows waves to flow through holes in the prestressed concrete instead of smashing against a solid structure. Only a portion of the impact force of a wave is reflected initially, most of the wave's energy flowing through the holes of the perforated breakwater into a chamber, where it is absorbed by friction and turbulence. The wave itself raises the level of the water in the chamber. Part of the force of the next oncoming wave is dissipated by the counterwave which flows back out from the chamber between the storage tank and the wall. Thus, the constant rise and fall of wave energy

is reduced to a level that saves the inner storage tank from being battered by the brutal North Sea waves, which can reach a height of over 75 feet. About 60 per cent of the total wave energy is dissipated in the chamber between the perforated breakwater wall and the storage tank.

When operating, the nine compartments of the storage tank are always filled with either water or low sulphur crude oil with a specific gravity of 0.83 or a combination of both. The storage compartments are kept pressurized by a water tower on the top of the tank. During the tank-filling operation, the oil enters from the production separators and pushes out the seawater contained in the tank. Any residual oil in this water is removed and retained before the water is flushed into the water tower. Water level in the tower is maintained to replace automatically the oil pumped out of the tank. An internal plumbing system removes sludge from the bottom of the tank by agitating and flushing it with high pressure water jets. Oil is pumped into the tank through a 30-inch line which also serves as the discharge line for pumping oil into the holds of tankers.

The oil-water levels are continuously monitored by a system of instruments and controls in the tank. Other auxiliary equipment includes automatic venting, a fire-fighting system and required navigational aids.

Engineering and testing

The concrete and prestressing engineering was performed by Europe Etudes, Paris, and Société technique de l'utilisation de la précontrainte, Paris, both companies acting as sub-contractors. A three-dimensional finite elements analysis carried out at the University of Calgary, Calgary, Alberta, with the help of Professors A. Caili, W.H. Dilger and Y.K. Cheung showed that the stress-strain relationships derived from calculation and adopted from the design were adequate.

For the concrete structures the design standards followed were those of the American Society for Testing Materials, the American Concrete Institute and the Norwegian Concrete Code. The recommendations of the Comité européen du béton - fédération de la précontrainte were applied to the post-tensioning system.

All present indications are that the

storage tank will be used safely and successfully. If the perforated storage tank proves to be an efficient and safe means of storing crude oil at an offshore drilling site and providing stable and strong deck areas, the sea platform may be used to provide marine bases for oceanographic studies and other industrial applications such as offshore nuclear power plants and offshore oil and gas drilling and production platforms. (From Science Dimension, April 1973 issue, National Research Council of Canada.)

Governor General's literary awards

Six books chosen by the Selection Committee of the 1972 Governor General's Awards for Literature were announced on April 17 by the Canada Council.

The winning books are: *The Manticores* (McMillan), a novel by Robertson Davies; *Civil Elegies and Other Poems* (Anansi) by Dennis Lee; *Lies* (McClelland & Stewart), a book of poems by John Newlove; *Histoire économique du Québec 1851-1896* (Fides) by Jean Hamelin and Yves Roby; *Signaux pour les voyants* (Hexagone), poems by Gilles Hénault; and *Don l'original* (Leméac), a novel by Antoine Maillet.

The awards will be presented by Governor-General Roland Michener on May 16. The authors will also receive cash prizes of \$2,500 each from the Canada Council.

An 18-member selection committee chose the winners from 400 literary works by Canadians published in 1972. Co-chairmen of the committee were Robert Fulford, editor of *Saturday Night*, and historian Marcel Trudel.

Members of the fiction sub-committee were Joyce Marshall (head, English section), Jean-Cléo Godin (head, French section), Ernest Buckler, Robert Kroetsch, Jean Ethier-Blais and Antoine Sirois. The poetry and drama section was headed by Eli Mandel and Suzanne Paradis, and included D.J. Jones, Sheila Watson, Rina Lasnier and Jean-Louis Major. For non-fiction there were Robert Fulford (head, English section), Marcel Trudel (head, French section), Gregory Baum, William Eccles, Maurice Blain and Robert Vigneault.