



NRC collaborates with Baird & Associates on successful physical model study of Port d'Ehoala

NRC-CMRC

Ocean, Coastal and River Engineering

Strong partnership leads to realization of a \$145M port development in Madagascar

With the majority of the world's population living along coasts, engineers must consider the effects of waves and water levels, and sometimes ice, when designing coastal infrastructure facilities. These natural forces can cause operational and safety issues, as well as structural damage, with the potential for significant financial consequences. When Baird & Associates (Baird) approached the National Research Council (NRC) in 2004 to undertake physical modeling for a port in Fort Dauphin, Madagascar to assess these risks, the NRC team was up for the challenge.

Baird's and NRC's efforts began in 1990, when Baird was approached to assist with the site selection and feasibility study of a new port facility for a mining development in southeast Madagascar. NRC completed physical model tests of a unique "berm" breakwater concept developed by Baird that had potential for substantial cost savings. Political and market factors resulted in the project being postponed for an extended period. However, in 2004, Rio Tinto proceeded with the project, retaining Baird to complete design development for the port.

Work began at NRC's world-leading hydraulics laboratory, where a physical model study was conducted to help Baird estimate "downtime" for the port, or the operational time lost due to inefficient or unsafe working conditions caused by excessive motions of moored ships caused by wave action.

"Understanding the response of moored ships to wave action is vital information when designing a port," said Mr. Dave Anglin, P.Eng., a senior coastal engineer and Principal with Baird. "Working with NRC allowed us to use one of the best facilities in the world for this type of work, with experts that we have a long-standing relationship with. NRC is our first choice for doing this type of work."



Experts from Baird and NRC collaborated on the project over four months, planning, designing, constructing, testing and analysing a 1:75 scale physical model of the proposed port, including the breakwater, quay wall (dock), dredging and a 35,000 DWT bulk carrier.

The testing took place in NRC's multidirectional wave basin, where a wide range of regular, irregular (long-crested) and multi-directional (short-crested) wave conditions can be generated. The model ship was moored against the quay wall using instrumentation systems simulating mooring lines and fenders.



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The team then measured the motions of the ship and the loads on the mooring lines and fenders in various wave conditions. The results of this study were combined with long-term wave climate data (developed using numerical model procedures) and published thresholds for allowable ship motions and mooring loads to estimate downtime for the proposed facility.

Equipped with this vital information, Baird was able to assess the economic feasibility of the project, refine the port layout (in particular the length of the breakwater, which is one of the most significant cost elements) limiting downtime to an acceptable level.

Since the 1980s, Baird has collaborated with NRC on studies to assess coastal engineering challenges for projects on oceans, lakes and rivers. "When collaborating with NRC, we value the opportunity for our engineers to develop and refine the design in the wave basin," said Mr. Anglin. "This provides them with a much better understanding of the processes at work, the model results and limitations. This hands-on experience has significant benefits, including the ability to quantify the performance of the project before it's built, demonstrating it to our client and refining the design to improve performance and/or reduce cost."

The \$145M Port d'Ehoala project was completed on time and under budget in 2009, winning the 2010 American Society of Civil Engineers, COPRI (Coasts, Oceans, Ports & Rivers Institute) Large Project Excellence Award and has become a cornerstone for expanding the regional economy. NRC continues to collaborate with Baird, and many other organizations, on the application of physical and numerical models to ocean, coastal, marine and river engineering projects throughout the world.



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