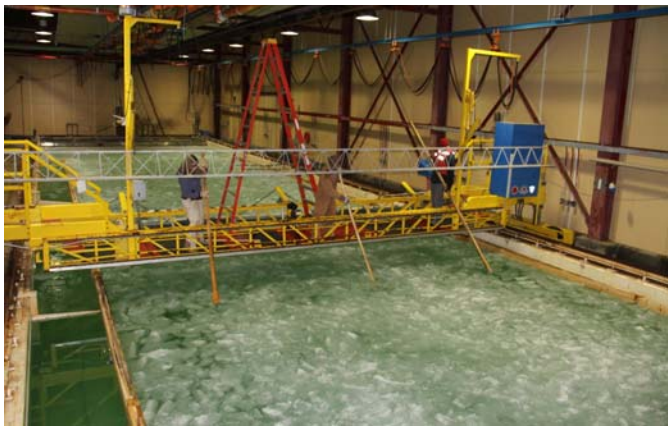
CRREL Ice Engineering Test Basin

Providing a simulated polar environment for evaluating system performance in ice covered waters



The carriage assembly above the Test Basin is used for instrumentation, general monitoring, and measurement of ice properties

The Test Basin in the Ice Engineering Facility at ERDC's Cold Regions Research and Engineering Laboratory (CRREL) is the largest refrigerated tow tank in the United States. The tank is ideal for evaluating ice on structure interactions under simulated cold region environmental conditions. Fresh water ice, sea ice and, for scale model tests, urea ice can all be produced in the basin. Since ice properties are closely controlled, via seeding practices, water temperature and freezing rate control, the Test Basin can be used to support a wide range of science and engineering efforts.

Previous science and engineering activities performed in the Test Basin include:

- Ship model testing for hull and propulsion performance
- Developing and evaluating a Rip-Rap shore protection system
- Detecting oil in and under ice
- Chemical herding of oil in ice
- Studying the phenomenology of gas exchange in ice covered water
- Testing floating ice covers
- Growing ice for collaborating agencies

Success Stories

CRREL conducted a scaled physical model study for the US Coast Guard in 2013 to study capabilities, limitations, and potential design improvements to personnel rescue vessels in the seasonal ice conditions encountered off the north coast of Alaska

Due to a potential increase in ship traffic in the Arctic, the US Coast Guard investigated the range of ice conditions in which their current small, non-ice-hardened vessels could operate. Their goals were to understand the capabilities of propulsion systems already in their inventory and to look for future development or refinement opportunities. Using a model craft equipped with shrouded and open propellers and an intake pumping propulsion system, a series of tests in brash ice were conducted. Using the test basin, brash ice was produced at varying thickness to account for seasonal variations. Results determined appropriate speeds for operations in brash ice conditions, speeds that minimized ice impacts on the propulsion systems. The study also provided insight into how effective propeller shrouds were and how well the waterjet impellers performed relative to the propeller based systems. Results from studies like this will allow the US Coast Guard to, in a cost effective manner, allocate their resources to the arctic region in an appropriate manner.

Features

Jesse Stanley, Engineering Resources Branch, establishes the air moisture conditions necessary to grow seasonal brash ice (annual pack ice in the process of melting) in the Test Basin

- A main tank 120 × 30 × 8 ft with a 10 × 10 ft preparation tank on the east end and a melt tank on the west end for ice disposal
- Refrigeration capable of 15°F to ambient with limited surface wind to achieve uniform ice thickness
    - A submerged Ice Builder Coil maintains water temperature while the ice is forming
- A monorail with a 2.5 ton crane on the center line of the tank, 14.5 ft above the water level
- A main carriage with a 1000 lb load rating on all axes with a 7 ft/sec speed
    - High Force modules can be attached under the carriage, which is capable of a 10,000 lb load on all axes with 2 m of travel
- A personnel carriage with two variable frequency drive (VFD) motors
    - movement along the tank and jacks to lift the bridge 14 in. provides access to the ice during the growing process and to obtain measurements of the engineering properties of the ice

Instrumentation

CRREL tests the durability and transport feasibility of a fuel bladder system to withstand difficult terrain conditions, such as sastrugi. The bladders are dragged across Antarctic terrain en route to refueling the National Science Foundation's South Pole Station.

- An underwater carriage is in the design phase and is anticipated to be fully installed in mid-2014, running the entire length of the test basin. It will be compatible with a variety of geophysical, remote sensor, A/V, and other instrumentation as needed on a project-specific basis.
- Main carriage: DAC Astro-Med TMX with 32 analog 6 strain gage channels, GPS, Video synchronized with data, digital I/O support and control, Ethernet connection via festoon
- Personnel carriage: instrumented for ice property measurements with analog output to the main carriage DAC
- The SCADA System monitors/controls air and water temperature with trending analysis and real time accumulated freezing degree hours for ice growth monitoring

The test basin is an ideal venue for evaluating ice forces on structures. In addition, an ability to stringently control ice formation makes the basin an ideal test bed for investigating environmental effects on above and below ice signal propagation. Being a temperature controlled facility, the basin provides a cost effective means of investigating sensor performance under simulated polar conditions. Specific applications in domain awareness and oil spill detection are possible.

ERDC Point of Contact

Questions about the Ice Engineering Test Basin?

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