The perfect wave – measured by imc

Application note: Stability tests of ships, harbors & oil platforms in waves

The enormous force of water in a crashing house-high wave – what extreme surfers may admire as a spectacle of nature can be a serious menace to ships, harbors and oil platforms which have not been designed and protected adequately. The Canadian research institute NRC (National Research Council of Canada) conducts comprehensive proving and certification tests on behalf of shipbuilders, port construction companies and manufacturers of oil platforms. For this purpose, measurement technology from imc is being applied.

Safety on the high seas

When the champagne bottle bursts against a ship's hull at its christening, the officiant wishes the vessel "ever a hand's width of water beneath your keel", before it sets out on its maiden voyage. This traditional ceremony aims to protect against calamity at sea. Although the sentiment is well meant, clearly a hand's width of water is not enough in most cases! Ships are always facing emergencies caused by storms and giant waves. Solidity and stability are the crucial factors. For this reason, testing during the development phase is essential – no ship may be launched without passing a certification test. Already in the shipyard, engineers, many of whom have themselves spent years at sea, closely monitor every stage of construction.

Additionally, ships are regularly subjected to a kind of technical inspection, an examination in which all systems are checked and the hull and equipment are investigated for any possible flaws.

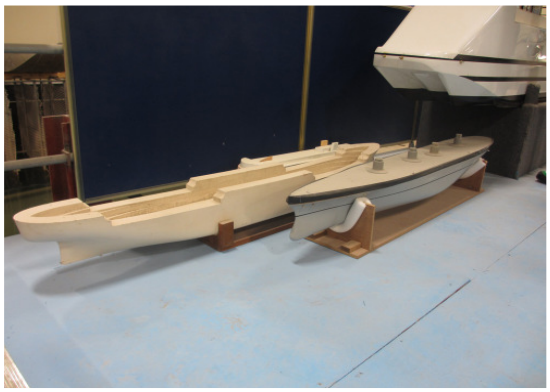
NRC researches for greater safety

Analog modeling

Even before the first assembly drawing of a ship is ready, testing by means of analog modeling is already under way. In Canada, the government institute NRC (National Research Council of Canada) uses imc measurement systems to assess the stability properties of maritime objects. This is work is commissioned by shipyards, port construction firms or manufacturers of oil platforms. For the purpose of inspecting maritime objects, NRC's Hydraulics Centre, located in Ottawa, has its own wave pool measuring 26 x 36m and 3m in depth. This pool realistically models environmental conditions in miniature.

Wave pool at the NRC institute

A wave generator consisting of 60 moving segments produces a variety of wave structures – e.g. diagonal or straight waves, or waves which break at particular locations – striking test objects with various levels of force. The objects may be scaled-down facsimiles of ships or oil platforms, or of harbor facilities. The test objects are fitted with strain gauges and wave height sensors, in order to measure the forces which the waves exert on them. The data are captured and processed by imc measurement systems.

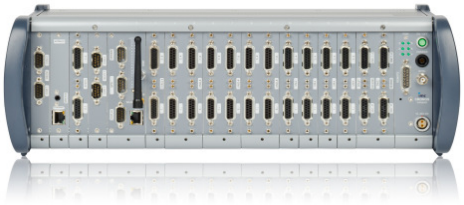


Example of a model ship

Demands on the measurement equipment

In order to perform the strain gauge measurements on harbor/ship facsimiles distributed over different locations, the NRC needed measurement instruments that could capture about 130 channels. Furthermore, a software interface that enables the NRC team to perform the tests easily was needed.

imc CRONOS*compact*: measurement, open- and closed-loop control all by one system



The NRC chose measurement devices of the type imc CRONOS*compact*, because that measurement system's modular design, with its universal interfaces offered the NRC high flexibility to accomplish a wide variety of measurement tasks – and looking into the future, it is prepared to also control the wave generation by the cylinders additionally to capturing the 130 strain gauge channels' data.

In order to make the cylinders generate certain types of waves, they must move in certain ways. To do this, they can traverse through position profiles consisting of 40,000 points. The embedded processors in the imc CRONOS*compact* unit are prepared to control the cylinders in real-time and synchronously to the data acquisition. This step is planned to enable a better integration of both these testing aspects in the future.

Besides using strain gauges, the institute also wished to measure the wave height using special sensors. For the purpose of parameterizing these sensors, imc provided a special routine. Each wave height sensor was to measure several points, and then a normal factor-offset-scaling was to be calculated by linear approximation and applied. imc developed an intuitive user interface based on NRC proprietary software which it had previously been using. Another factor contributing to the overall solution's productivity was the design of the data storage structure – the calibration values were saved for future reference in such a way that they can easily be displayed at any later time.

Conclusion

The customer's advantages at a glance:

- Integration of measurement and control capabilities
- Flexible and compact measurement devices, wide spatial distribution possible while measuring near the sensor
- Expandability
- User-friendly software
- Integration of existing data formats

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imc Test & Measurement GmbH is a manufacturer and solution provider of productive test and measurement systems. imc implements metrological solutions for research, development, service and production. imc has particular expertise in the design and production of turnkey electric motor test benches. Precisely outfitted sensor and telemetry systems complement our customer applications.

Our customers from the fields of automotive engineering, mechanical engineering, railway, aerospace and energy use imc measurement devices, software solutions and test stands to validate prototypes, optimize products, monitor processes and gain insights from measurement data. As a solution provider, imc offers their customers an attractive and comprehensive range of services. These include project consulting, contracted measurements, data evaluation, specialist deployment, customer-specific software development and system integration. imc consistently pursues its claim of providing services for “productive testing”.

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