The Marine Structures Testing Lab of DITEN

General info

Since 1964 the Laboratory allows the implementation of tests and sea trials on full and large scale specimens of ships and offshore structures. It was originally established in order to solve the large number of problems of shipbuilding: it is indeed possible to design and to perform unconventional testing, not yet defined in current practice, as well as to select most adequate instrumentation, to draft testing specifications according to the goals of the research and to critically analyze the measured data.

The Laboratory is equipped with devices and tools for static and dynamic tests on large-scale models of ship and offshore structural components and for research into a variety of problems related to ship strength. In several cases the testing equipment and the measurement systems were not bought on the market rather they were designed and built in house as, beside structural mechanics and shipbuilding skills, the Lab can rely on know-how about electronic systems (hardware and software). The achieved results have contributed significantly to the verification of new design criteria, so enhancing the development of naval architecture and marine engineering.

Moreover, the Laboratory was created with the purpose of solving specific problems arising within the research field and requiring the advancement of specific skills, supported by decades of experience. The laboratory staff is then familiar with the development of non conventional experimental tests in order to capture the desired physical quantities along with the critical analysis of the results obtained.

Facility Description

The laboratory is located within the Polytechnic School, in Genova, in the Albaro suburb, with a private road access allowing the entrance of large scale models.

Around the facility area, which measures 31 m in length, 12 m in width and 6m in height, are also located the offices hosting researchers, technicians and PhD students usually involved in the testing activities.

The test area of the laboratory consists of a strong floor, whose dimensions are 18.0 x 6.0 m; dedicated mechanical components allow for fixing the structures under testing as necessary: the full surface of the strong floor is in fact fitted with connection holes suitable to fix constraining components and allowing to create the desired testing configuration. The system allows for the application of significant loads and the arrangement of test specimens in optimum conditions.

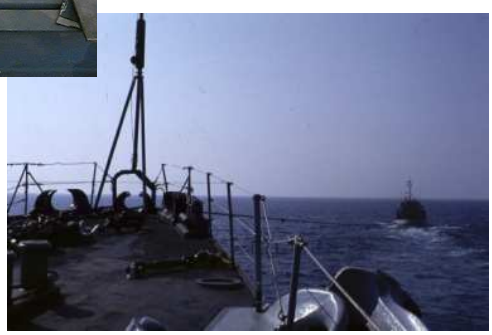
The strong floor is isolated from the outside because it is installed over an elastic support on its edges and it is particularly convenient for testing vibration and structural noise on large-scale specimens.

In the laboratory, a steel testing bench is available for tensile and compression tests, with a length of 12.0 m and a width of 2.0 m, where a maximum load of 3000 kN (tension or compression) can be applied.

Experimental test equipment

The main equipment available in the Marine Structures Testing Laboratory of DITEN include:

- Strong floor, dimensions 18x6x1.1m
- Crane with a lifting capacity of 50 kN and an elevation of 4.5 m
- A testing bench for tensile and compression tests
- A pressure chamber to test structures under external pressure
- Two static tests machines (pendulum machines) including calibrated hydraulic actuators
- A hydraulic power unit (MTS) for dynamic tests with a range of servo hydraulic actuators and Moog valves (self-built control system)
- Several acquisition systems and post processing software for fatigue tests, modal analysis, wave loads and sea keeping, etc.
- Several transducers for different physical quantities: load cells, strain gages, displacement sensors, pressure sensors (static and impulsive), accelerometers, instrumented hammers for modal analysis, clinometers, rate gyros, etc.



The following hydraulic actuators and load cells are currently available:

HYDRAULIC ACTUATORS

Simple effect

No	Maximum load kN (t)	Stroke mm
2	9.81 (1)	140
2	24.525 (2,5)	140
2	49.5 (5)	140
2	98.1 (10)	140
2	196.2 (20)	140
2	196.2 (20)	100

Double effect

No	Maximum Load kN (t)	Stroke mm
8	196.2 (20)	200
2	392.4 (40)	200
2	1471.5 (150)	150

LOAD CELLS

No	Maximum Load kN (t)
8	196.2 (20)
2	392.4 (40)
1	784.8 (80)
1	981.0 (100)
2	1471.5 (150)

Main research activities conducted in the Laboratory

Possible experimental tests

The experimental analyses that can be performed in the lab are summarized as follows:

- Structural response to static and dynamic loads of ship and offshore structures, also in large scale and including composite structures, with emphasis on fatigue tests of welded structures in general
- Measurement of forces, stress, deflection and strain patterns of large scale and full scale structures under working conditions (e.g. pressures and deformations on ship hulls)
- Dynamic and impact pressure measurements due to fluid motions (slamming and sloshing)
- Hull motions measurements using traditional systems (e.g. accelerometers, rate-gyro, gyroscopes, etc.) as well as by Real Time Kinematic GPS systems
- Acceleration measurements in different frequency ranges either on small and large scale specimens or full scale structures aimed at defining displacements, vibrations and structural noise
- Wave measurements either offshore or inshore (e.g. wave wash measurements)
- Forces and moments measurements developing load cells “on demand” for particular applications
- Tests on structures under external pressure (pressure chamber tests)
- Characterization of visco-elastic materials for vibration damping
- Design and construction of structural monitoring systems for ships and offshore structures
- Development of ad-hoc sensors and measuring systems for specific needs

In the laboratory collapse load tests can be performed on ships structural elements like steel or composite stiffened panels, along with fatigue tests on large scale models, made necessary by the significant scale effect affecting this phenomenon. The laboratory gained experience over the last 40 years in this field. Strain gages and load cells allow the measurement of the stress field distribution during the experimental test.

By using a pressure chamber, external pressure tests have been conducted on cylindrical elements up to structural collapse; such equipment was recently useful in the frame of a research project on submarine cables.

Since 1975, the former DINAV department, now DITEN, has been conducting a series of sea trials, in order to carry out experimental measurements to determine the ship’s frequency response, also operating in severe environmental conditions like the Antarctic Ocean.

The direct measurement of the external hull pressure through pressure gauges installed on hull surfaces and the acquisition of the ship’s motion by modern technologies like the GPS RTK satellite system, proved themselves to be very useful in the calibration process of a reliable numerical model in order to determine the impulsive loads.

What previously described is studied in parallel through analytical and numerical methods, such as FE models. The laboratory is provided by several commercial software also used in educational activities: moreover acquisition and elaboration software have been self-developed by the laboratory staff in the last years.

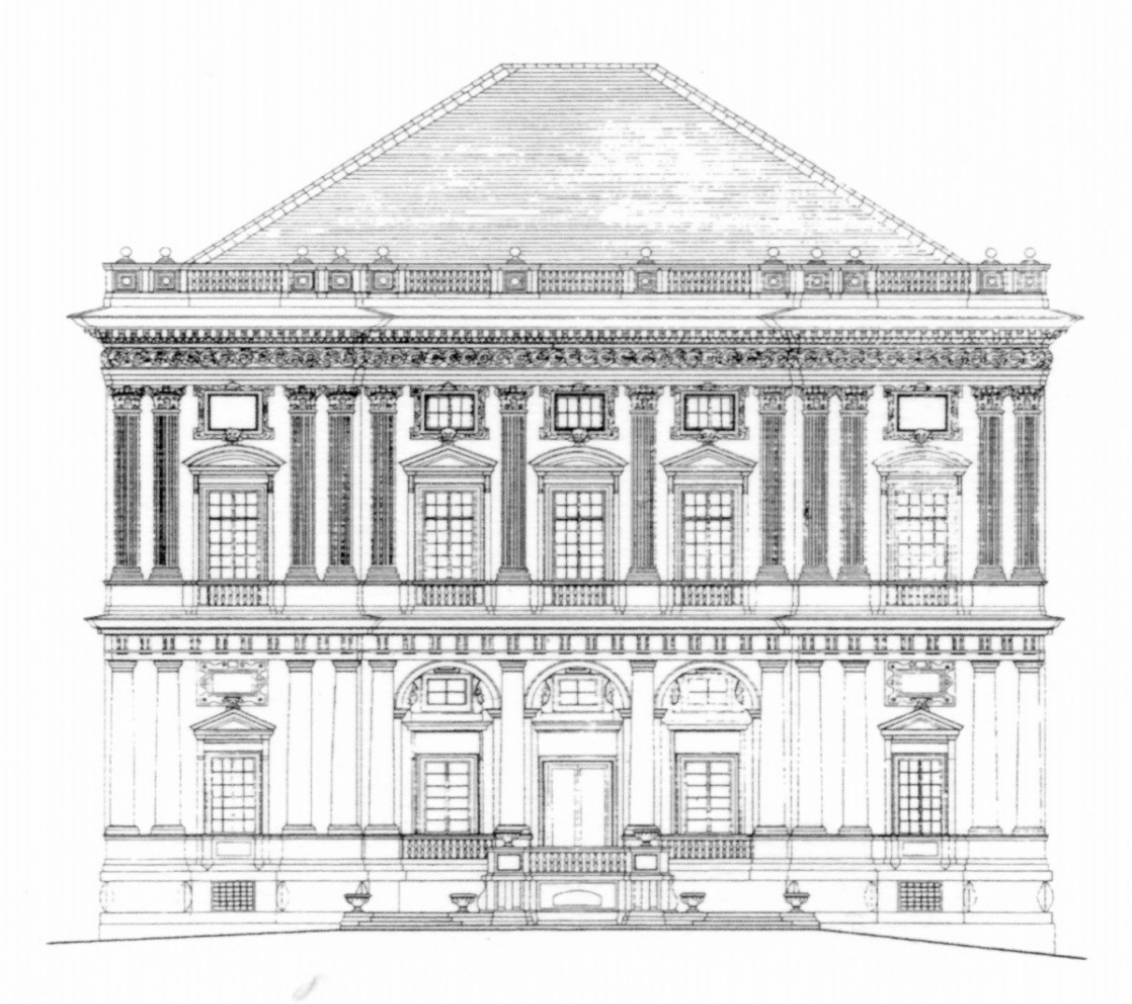
Recently, cooperation activities have started concerning fluid/structure interaction problems and taking into account theoretical/numerical approaches supported by experiments previously conducted in the DITEN Marine Structures Testing Lab.

Hull pressures, strain & motion - 1978

The Department

DITEN

Department of Electrical, Electronic, Telecommunications Engineering and Naval Architecture
Polytechnic School, University of Genoa



Marine Advanced Testing & Sea Trials

Marine structure Laboratory

DITEN - Università degli Studi di Genova, Viale Cambiaso 6, 16145 Genova

For more info:

Ing. **Cesare M. Rizzo**

tel. + 39 010 353 int.2422/2272/2246

Email: cesare.rizzo (at) unige.it