# Physical model testing of flooded collision-damaged ship hulls

**Background and motivation**

When two ships collide, the struck ship will be damaged in the side-shell with a damage opening. The position, shape and size of the damage opening affect the stability conditions of the struck ship, and also the outflow rate of cargo (such as oil) if the struck ship's inner side-shell is penetrated by the striking ship. There exists simulation models that can simulate the flooding conditions and cargo outflow conditions. However, they are often very advanced and not suitable to be integrated in simulation tools developed for decision support tools which require rapid results.

**Objectives and goals of the project**

This project will make an inventory of which softwares and codes that can be used as a basis to create a simplified and rapid flooding/cargo outflow code that can be integrated in a decision support tool. A small scale physical model of a damaged ship should be built. It will be used in experiments to carry out parametric studies where some of the cases also will be simulated with a numerical code for verification purposes. The goal is to create an empirical relationship how the position, shape and size of the damage opening affect the stability conditions of the struck ship (together with the ship's orientation and (potentially) approaching wave) and also the outflow rate of cargo (such as oil).

**Methods and tools**

A literature study should be carried out to list different codes and softwares that can be used to simulate flooding, cargo outflow and ship stability conditions.

The students should design and build a small scale physical model of a double-hull ship compartment. It should be possible to vary the shape and size of damage openings in the structure, both in the outer and inner side-shell structures. Also, as a subtask: a proper substitution of liquid cargoes for use in the experiments to include also effects from different densities and viscosities between the cargo and the seawater.

Numerical simulations of some of the experiments that have been carried out using the physical model. Develop a mathematical model based on empirical relationships that can predict the flooding and cargo outflow rates.

The thesis should be written in Word using a template provided by the department.

**The MSc thesis project should incorporate (at least) the following tasks:**

- Literature study.
- Inventory of simulation softwares and codes.
- Design and build a physical model (see above).
- Conduct experiments using the physical model, verification with numerical simulations.
- Develop a mathematical model based on empirical relationships that can predict the flooding and cargo outflow rates.
- Write a thesis report and present it on a public seminar.

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