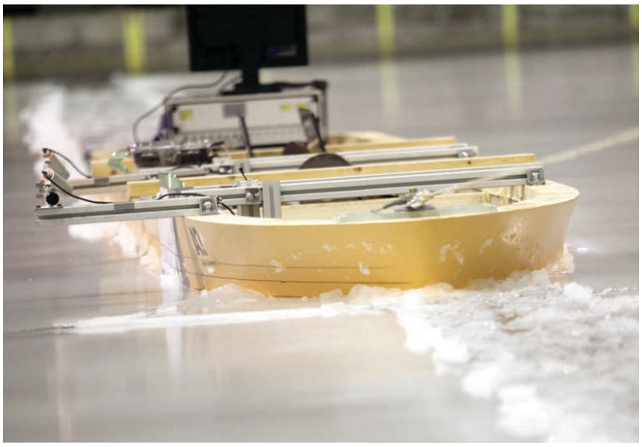
5.6.2017

ARCTIC TECHNOLOGY

The importance of Arctic Technology is high as the marine traffic and industrial activities in ice-covered seas are increasing. The Arctic environment, including the Baltic Sea, is however very sensitive and impose strict requirements for safety and sustainability on all operations. This has created a demand of engineers who have specific Arctic competencies.



Arctic Technology package provides students with deep understanding of different engineering issues related to cold marine environment. These include design of ships for the harsh Arctic environment, and understanding of the behaviour of sea ice. The courses deal with winter navigation, ice loads on ships and structures, design of structures, hydrodynamics, ice mechanics, and applied mechanics in general.

Aalto University is one of the leading institutions in research related to Arctic Technology. The students studying Arctic Technology are able to participate in model scale experiments in a unique test facility, Aalto Ice Tank, and will get to know the state-of-the-art analytical and numerical methods used in Arctic Technology. There are two study paths,

- **Arctic Marine Technology**
- **Arctic Offshore and Ice Engineering**

which are described below in detail. The study paths can also be modified based on the interest of the student by selecting courses from other education packages of the Master programme.

Graduates of Arctic Technology may work in consulting and design companies, classification societies, governmental bodies, shipyards, or in research institutes and universities.

Study path: Arctic Marine Technology

Profile:
In Arctic marine technology the key competence is to understand the cold environment and its effects on the ship design, hull shape, power requirements, navigation in ice and safety of ships. This requires basic knowledge on ship design, risk analysis, solid and fluid mechanics and especially understanding of the characteristics of ice as a special material. Aalto ice tank will be utilised in the teaching as one course will concentrate on model scale testing in ice. In addition, a few days excursion to the icebreaker operating in the northern Baltic Sea is organised every winter as part of the winter navigation course.

Studies:
List of suitable courses for this study path is shown on the right, with recommended (RE) and optional (O) courses. All courses are 5 ECTS.

Work environment:
Shipyard, design and consulting offices, ship owners operating in ice, offshore companies where innovative arctic ship designs and operational plans for ice environment are created. Alumni example is s person, who works in an oil company and has e.g. active role in the recent large LNG projects in the Russian Arctic.

Courses

Common studies	
Engineering in Society (obligatory)	
Principles of Naval Architecture	RE
Dynamics of rigid body	RE
Dynamics of structures	RE
Random loads and processes	RE
Fluid dynamics	O
Finite element method in solids	O
Selection of engineering materials	O
Marine Technology	
Ship buoyancy and stability	O
Ship hydrodynamics	O
Ship structures and construction	O
Ship design portfolio	RE
Marine risks and safety	RE
Ship dynamics	O
Ship systems	O
Arctic	
Winter navigation	RE
Ice loads on structures	RE
Ice mechanics	RE
Small scale testing in ice	RE
Solid Mechanics	
Finite element analysis	O
Beam, plate and shell models	O
Fatigue of structures	O
Fracture Mechanics	O
Thin-walled structures	O

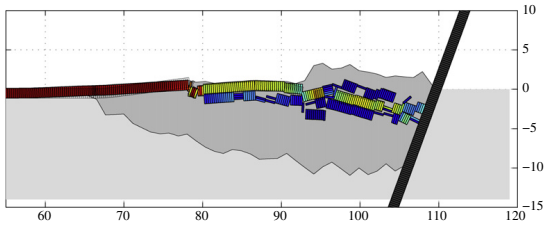
Study path: Arctic Offshore and Ice Engineering

Profile:
A key competence needed in Arctic engineering is to understand the requirements that the harsh Arctic environment and the sea ice loads set on the offshore structures. The work of a specialist in this requires fundamental understanding on applied mechanics and structural design, and how these fundamentals should be applied in the Arctic. A skilled specialist has to understand the mechanics of the offshore structures, the complicated mechanics behind the ice loads, and also other environmental loads acting on offshore structures.

The graduates will understand the fundamentals of Arctic offshore engineering and ice loads, and will be familiar with analytical and numerical modeling techniques related to them. They will also know how to conduct model scale experiments, which are widely used in Arctic engineering.

Studies:
List of suitable courses for this study path is shown on the right, with recommended (RE) and optional (O) courses. All courses are 5 ECTS.

Work environment:
Arctic Engineering Specialist may work in consulting and design companies, classification societies, governmental bodies, shipyards, oil companies, or in research institutes and universities with activities on ice-covered waters.



Courses:

Common Studies	
Engineering in Society (obligatory)	
Modelling in Applied Mechanics	RE
Dynamics of Rigid Body	RE
Dynamics of Structures	RE
Finite Element Method in Solids	RE
Fluid Dynamics	O
Random Loads and Processes	O
Marine Technology	
Marine Risks and Safety	RE
Computational Marine Hydrodynamics	O
Computational Fluid Dynamics	O
Methods in Comp. Fluid Mechanics	O
Arctic	
Winter Navigation	RE
Model Scale Testing in Ice	RE
Ice Mechanics	RE
Ice Loads on Structures	RE
Solid Mechanics	
Finite Element Analysis	RE
Beam, Plate and Shell Models	RE
Fatigue of Structures	RE
Fracture Mechanics	RE
Continuum Mech. And Mat. Model.	O

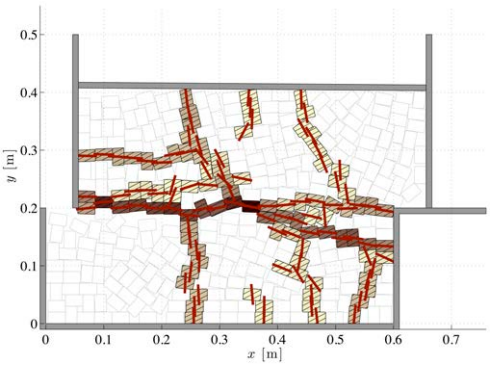
Nordic Master in Cold Climate Engineering: Sea Track

Profile:
This study path focuses on Arctic ships and offshore structures. The studies are conducted in two universities (one year in each): Aalto University and Norwegian University of Science and Technology (NTNU). The study path gives a comprehensive overview of the different aspects related to the design and analysis of Arctic ships and offshore structures as well as operations on ice-covered waters.

The study path covers both the basic knowledge as well as application of Arctic marine technology. During the studies, the students have the possibility to participate on Arctic fieldwork in Svalbard (UNIS), laboratory work at the Aalto Ice Tank and numerical modelling of ice related problems. The path leads to a double degree as the graduates will receive a degree from both Aalto University and NTNU.

Studies:
List of courses for this study path are shown below (all courses 5 ECTS). **Note that these studies include obligatory courses. More info and courses offered by NTNU can be found from www.coldclimate-master.org.**

Work environment:
Arctic Engineering Specialist may work in consulting and design companies, classification societies, governmental bodies, shipyards, oil companies, or in research institutes and universities with activities on ice-covered waters.



Courses in Aalto (O=obligatory, E=elective):

Year of studies in Aalto:	1st	2nd
Common Studies		
Dynamics of Rigid Body	O	E
Dynamics of Structures	O	
Finite Element Method in Solids	O	
Fluid Dynamics	O	O
Random Loads and Processes	O	E
Marine Technology		
Marine Risks and Safety		O
Ship Hydrodynamics		E
Computational Fluid Dynamics	O	
Ship structures and construction	E	
Arctic		
Winter Navigation	O	O
Model Scale Testing in Ice	O	O
Ice Mechanics	O	E
Ice Loads on Structures	O	
Solid Mechanics		
Finite Element Analysis	E	
Beam, Plate and Shell Models	E	
Continuum Mech. And Mat. Model.	E	