



# Naval Architecture

Overview of the naval architecture education at KTH  
2016



## Introduction

Naval architecture, or *marina system* as we call it in Swedish, is an engineering discipline that considers boats, ships, and other marine technology systems such as offshore wind power plants and subsea systems. Studying naval architecture give you the opportunity to deepen and apply your theoretical knowledge and understanding of mathematics and mechanics, and along with that developing your system thinking, your engineering design skills, and your abilities for team work, communication and management. The naval architecture education at KTH is characterized by a progressive learning environment with the student in focus and has a reputation of educating creative and skilful engineers for the maritime sector as well as for other branches of engineering in Sweden and internationally. The major part of the education is on master level, but you also have the opportunity to take an introductory course in the third year of your *civilingenjörs* studies and to do a naval architecture bachelor thesis.



## Third year studies

In the third year of your *civilingenjörs* studies you can get a first taste of naval architecture by taking the course:

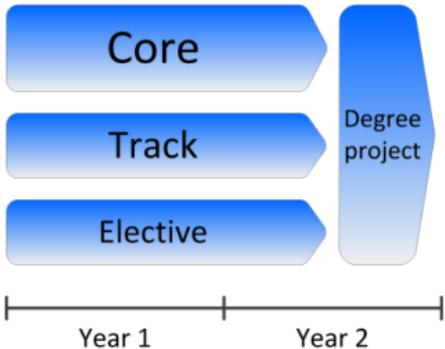
**SD2725 Introduction to marine technology 6.0 cr**

This will give you an introduction to the theory of ship stability, resistance and propulsion, the principles of ship design, and worldwide seaborne transportation. The course also includes experimental work and in a project you apply your knowledge and develop your skills by designing a ship to meet a certain transport scenario.

In the third year you can also choose to do a naval architecture bachelor thesis. Here you should conclude your bachelor studies by applying and deepening the knowledge and skills you have gained so far, in a naval architecture project. Previous students have for example studied: *Wind assisted cargo ships*, *Stability and survivability of damaged ships*, *High-speed craft dynamics*, and *Ships' energy efficiency*. The course SD2725 is a recommended preparation for the naval architecture bachelor thesis. Both SD2725 and the naval architecture bachelor thesis are good preparations for the naval architecture master program, you can however enter the master program also with another background.

### Master of science programme

The naval architecture master programme consists of a core of naval architecture specific courses. In parallel with the core courses you develop deeper understanding in a particular area by choosing one of three tracks: *Lightweight Structures*, *Fluid Dynamics*, or *Management*. There is also room for elective courses where you have the opportunity to specialize further within your track, to go deeper into ship design and marine technology, or to broaden your education by choosing courses from other tracks or from other areas suitable for you interests and career goals.



#### Core

The core of the naval architecture master programme consists of the three interlinked courses *Ship Design*, *Marine Structures* and *Marine Hydromechanics*. Here you develop fundamental theoretical knowledge and understanding, along with working skills in systems engineering and ship design. Through all these courses you will be working with designing a ship to meet

operational demands formulated by shipping companies. The courses also include experimental work in model scale and full scale on-board ships. The core consists of the courses:

SD2721	Ship design(*)	9.0 cr
SD2722	Marine structures	7.5 cr
SD2723	Marine hydromechanics	7.5 cr

(\*) If you have already taken the course SD2725 you should take the course SD2709 Underwater technology instead of SD2721. Program director and contact person for the core is Anders Rosén, aro@kth.se, 0702-580210.

### Track: Lightweight structures

In this track you combine naval architecture with knowledge about modern materials and structures and related design principles and manufacturing methods. Sweden and KTH has been fore runners in research and application of composite materials in ship structures as well as in other applications. Composite materials are today used in pleasure boats, advanced race boats and specialized vessels and there is a great potential in extending the use also in other types of ships for increased performance and decreased environmental impact and cost. The track consists of the courses:

SD2411	Lightweight structures	8.0 cr
SD2413	Fibre composites - analysis and design	6.0 cr
SD2416	Structural optimization & sandwich design	6.0 cr

Contact person for the Lightweight Structures track is Dan Zenkert, danz@kth.se, 08-7906435.

### Track: Fluid mechanics

In this track you develop your fundamental understanding and working skills in incompressible fluid mechanics, which is the basis for the flow around ships, boats and marine installations. The Navier-Stokes equations, are derived, dissected, simplified and solved, and the characteristics of boundary layers are investigated. The fundamental mathematical principles of modern computational fluid dynamic tools (CFD) are introduced and in hands-on projects you will use such tools when modelling and solving complex flow patterns in real problems. Track courses:

SG2214	Fluid mechanics	7.5 cr
SG2212	Computational fluid mechanics	7.5 cr
SG2224	Applied computational fluid mechanics	5.0 cr

Contact person for the Fluid Mechanics track is Luca Brandt, luca@mech.kth.se, 08-7906870.

## Track: Management

In this track you complement your technical knowledge with knowledge of organizational and managerial aspects, and develop your understanding of the concepts of sustainable development from environmental, social and economic viewpoints. Emphasis is on the ability to manage and control projects, strategies for sustainable development, and management tools and systems analysis methods. This gives you a foundation for employment as a manager of projects within the maritime sector as well as in other types of industries. The courses in this track are:

EH2720	Management of Projects	7.5 cr
AL2160	Environmental Management	7.5 cr
AL2181	Environm. System Analysis and Decision-making	7.5 cr

Contact person for the Management track is Monika Olsson, monika@kth.se, 08-7906150.

## Elective courses

In addition to the courses in the core and in your chosen track you have the opportunity to specialize further within your track, to go deeper into ship design and marine technology, or to broaden your education by choosing courses from other tracks or from other areas suitable for your interests and career goals. Here are a few examples of elective courses:

SD2702	Naval design	20 cr
SD2705	High speed craft	6.0 cr
SD2709	Underwater technology	7.5 cr
MO1002	Oceanography (at Stockholm University)	7.5 cr

See more elective courses in the program plan on the KTH web.



*Students in the course Naval Design winning a race for solar powered boats in Japan in collaboration with students from the University of Tokyo.*

## Degree project

The master programme is finalized with an individual study in the form of a 30 credit degree project. It can for example be a small research project, an advanced engineering analysis or a design project, and may be performed at KTH or another university or, more commonly, at a company with suitable infrastructure to provide sufficient supervision and resources. Previous students have for example studied: *Aeroelasticity in yacht sails and rigs*, *Future fuel for worldwide tanker shipping*, *Hydrodynamic investigation of wave power buoys*, *Material concepts for patrol boats in a life cycle cost perspective*.

## Some words from graduated students

### Sara Hedberg, graduated 2007



My choice of the naval architecture program at KTH emerged partly from my interest in sailing at the Sea Scouts and partly from what I heard about the dedicated teachers and teaching methods with realistic design projects. The fact that naval architects have the whole world as labor market I took advantage of when I did my degree project at the submarine company ASC in

Adelaide in Australia. When I got back home I landed in Stockholm on a Friday, on Monday I had a job interview, and a week later I had a job at the marine consultant company Saltech! After five years as a consultant, trying out many different workplaces, I decided to move on. Today I work with underwater systems as a development engineer at the Swedish Defence Materiel Administration.

### Torvald Hvistendahl, graduated 2010

The KTH naval architecture master program offers a dynamic study environment. If the first three years at KTH were about “filling up a backpack” with basic engineering knowledge the last two years were more about picking up gained knowledge and combine it on different aspects of engineering design. I will



never forget the first real sea trial with the electric hydrofoil craft “Evolvo” that we developed in the course Naval Design. After months of hard work and several fails, our test pilot pulled full throttle, the craft

accelerated and was soon taking off in hydrofoil mode. See it on YouTube! What I learned from that project regarding engineering, design processes, team work, decision making, and communication, is something I still lean on in my work as a project manager at the maritime consulting company SSPA.

### **Kristoffer Uulas, graduated 2012**

The naval architecture education has given me deeper understanding of hydrodynamics and structures. In the Naval Design course we designed and built an autonomous under-water vessel using glider technology. This was not only theoretically challenging but also gave practical experience that has helped me in my daily work. I did my master thesis project at KTH in cooperation with the two companies DNV and DIAB, studying application of composite materials in ship structures. The thesis work resulted in a job offer from DNV and right after graduation I moved to Oslo and started working as an approval engineer. The job gave me the opportunities to work with some of the most advanced



vessels being built in composite materials such as super yachts and patrol craft. After a couple of years I moved back to Stockholm and started working at the DNV office here.

## International exchange

As a naval architecture student at KTH you have several options for studying abroad. You could for example take an exchange semester in New York, Lisbon, or Southampton. The best time for an exchange is in the autumn year 2 of the master program, but other alternatives could also work out. You could also go abroad for your master thesis project; previous students have for example been in Norway, UK and Japan. Occasionally there is also international exchange within courses, as in the solar boat project in the course SD2702 Naval Design, where KTH students collaborated with students at the University of Tokyo which included a few weeks trip to Japan. If you are interested in spending one of the years of your master studies at KTH and the other in another Nordic country you should check out the master program *Maritime Engineering*.

## Career prospects

The multidisciplinary character of the subject naval architecture, and the structure and curriculum of the master program, make the education relevant for careers in the maritime sector as well as in other engineering fields. Within the maritime sector Sweden is a leader in a number of areas, such as ship operation, propulsion systems, and design and construction of high-technology ships and small craft. You find naval architects educated at KTH in shipping companies such as *Wallenius* and *Stena*; at shipyards such as *Kockums* and *Docksta*; at maritime consultants such as *SSPA* and *Saltech*; at system developers and manufacturers such as *Rolls-Royce*, *StormGeo*, and *Aveva*; at companies working with offshore energy such as *Hexicon*, *GVA* and *Bassoe*; at state authorities such as the *Swedish Transport Agency* and the *Swedish Defence Materiel Administration*; and at research institutions such as KTH, Chalmers and SSPA. Significant international employment markets for naval architects are for example found in Norway and in the large shipbuilding nations in Asia. Outside the maritime sector you find naval architects graduated from KTH in companies such as *Scania*, *Vattenfall*, *ÅF* and *ABB*. Naval architects educated at KTH for example work as system developers, ship designers, computational engineers, consultants, project managers, administrators, and as researchers. After graduating from the KTH naval architecture education you hence have opportunities to develop your career in many different directions depending on your interests.