

MECHANICS EDUCATION IN SWEDEN

Anders Boström

*Department of Applied Mechanics, Chalmers University of Technology,
SE 412 96 Göteborg, Sweden*

Summary The role of mechanics in the Swedish university system is described on the bachelor, master, and PhD levels. On the master and PhD levels the quantity and quality of the students are more or less satisfactory. On the bachelor level there are problems with many students performing too poorly. Recent and on-going changes in the system are briefly described.

INTRODUCTION

The education in mechanics in Sweden is of course very dependent on the engineering education in general. There has been and will continue to be great changes in this education, partly due to the Bologna process (the trend towards a more harmonized education system within Europe to promote mobility and transparency). The intention is here to describe how mechanics enters the engineering education at various levels and to try to give the strengths and weaknesses of the mechanics education.

Traditionally, the engineering education in Sweden leads to only two degrees, the Master and PhD degrees. The master programs have been 4 years, but switched to 4.5 years about 15 years ago. The PhD programs have been 4 years nominally for many years, but due to teaching and other assignments the real time has been around 6 years. The last couple of years the teaching load has decreased and the time is now around 5 years.

About 10 years ago, shorter engineering programs leading to a Bachelor degree were introduced. These programs are offered at many smaller colleges and now attract about the same number of students as the traditional master programs. The bachelor programs are more 'operational' and contain less basic science and more applied subjects. It is possible to enter a master program after 3 years with an appropriate Bachelor degree, but usually it is necessary to complement with courses in mathematics and mechanics. Rather few actually use this way to obtain a Master degree.

During the last 10 years international master programs have gradually increased in numbers. These offer specialized educations, e.g. in turbulence, structural engineering, and automotive engineering, and are for 1.5 or 2 years. These programs mostly attract foreign students but can also be chosen by the regular master students for their specialization.

BACHELOR PROGRAMS

The shorter engineering programs contain relatively little basic science and therefore only the programs in mechanical and civil engineering have courses in mechanics, typically introductory courses in statics and dynamics, strength of materials, and maybe fluid dynamics. Typically, the total amount of mechanics in these programs is 10-15 c.u. (credit units; in Sweden one academic year contains 40 c.u., each c.u. should correspond to one full week of work for the student). Optionally, one or two more courses may be taken in these subjects or in FEM.

There have been great problems with the quality of the programs, initially only about 20% of the students got their degree in reasonable time. This situation is somewhat better now, but at least partly this has occurred due to easier exams or other types of examination as home assignments (where many students cooperate and the accomplishments of the weaker students are very uncertain).

The first three years of the master programs also have introductory courses in mechanics. Typically all, or almost all, programs, also in chemical and computer engineering, have a course in statics and dynamics. In mechanical engineering the introductory courses amount to around 20 c.u. In addition, the quality of the courses and the demands on the students are generally high. The problem is instead that many students fail, typically only 50–80% of the students pass the courses the first time. Even after the two reexaminations that are offered during the year many students have still not passed a course. This leads to a situation where many students have courses left behind, which means that they may not get their degree until 5 or more years (compared to the nominal 4.5). One or two more courses in mechanics may be taken optionally, in particular many students take a course in FEM.

MASTER PROGRAMS

During the last two years the master programs contain a specialization and the students have a large variety of courses and programs to choose from. Those wishing to specialize in mechanics can take courses in advanced dynamics, continuum mechanics, advanced FEM, structural dynamics, material mechanics, fatigue, advanced fluid dynamics, CFD, turbulence, etc, and also more applied courses e.g. in machine elements, turbo machinery, automotive engineering, and acoustics. At this level the students usually perform well with almost all students passing their exams. Of the students in mechanical engineering around 25% take a specialization in mechanics, meaning that they take 30–40 c.u. of courses in mechanics. But also other students take courses in mechanics, some of the courses attract students from civil engineering, engineering physics, and automation engineering.

PHD PROGRAMS

Depending on the programs some 10–20% of the master students continue towards a PhD exam (in Sweden there is also an intermediate licentiate exam, after which some students quit). Only about 10–20% of the students come from abroad, this is partly due to the swedish system with using the PhD students also as teaching assistants which is mostly expected to be done in swedish. The PhD students are employed by the university for 5 years and the teaching load is usually 20%. In this way the students almost become as staff members. In general it is not difficult to attract good master students to become PhD students and the quality of the PhD students is thus satisfactory in most cases.

Unlike in many other countries the PhD program also contains a course part, typically 40–50 c.u. (about one year). These may be master courses, but the departments also offer in-depth PhD courses, often with direct coupling to the research. Due to funding reasons almost all PhD projects today are externally funded, and this is the limiting factor for the number of PhD students. The projects are thus often of a more applied nature, and this seems to be preferred by most students.

THE FUTURE

Presently, there is on-going work to further separate the bachelor and master levels. Still, it will be possible to be admitted to a program leading all the way to a Master degree, but an intermediate Bachelor degree will also be offered. It will also become more natural to enter at the master level with an appropriate bachelor exam. Although it is possible to complement the bachelor, this may still lead to problems for master programs in mechanics with students entering with a weaker background in mechanics than earlier.

Most master programs are presently 1.5 year, but there are advanced plans to make them all 2 years, both to conform better to other countries and to prepare better for the PhD program. Simultaneously there are more tentative discussions to reduce the PhD programs, the swedish program being very demanding in an international comparison.

As mentioned above there are problems with the mechanics education at the bachelor level with students performing too poorly. There are many discussions on how to tackle this. One change that is under way in some places is to concentrate the courses more and only have two courses running in parallel (presently the norm is three courses in parallel). Other suggestions include an increased use of computer-based learning methods and alternative examination forms such as project work and home assignments (with the problems of securing the quality of each individual student).

CONCLUSIONS

In summary it can be stated that the position of mechanics is relatively strong in the swedish university system. At the master and PhD level the trend seems to be positive with a good number of students of sufficient quality entering and performing well. At the bachelor level the situation is more problematic. Of the large number of students taking introductory mechanics courses at this level too many seem to be poorly motivated and to perform unsatisfactory. There is a large challenge in changing this.