

BEP- Mechanical Engineering

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1 Introduction

The Bachelor Final Project (BEP) concludes the Bachelor phase. The project has the character of a graduation project, but is considered an ordinary course of 14 EC. This is important for the cum laude regulation. The BEP runs twice a year over an entire semester: 3 EC in the first and 11 EC in the second quarter of that semester. A part of the BEP is assessed individually.

Parallel to the BEP, the course Engineer & Society is taught. The course consists of 2 EC theory (exam) and 2 EC written assignment (essay). The topic of the essay is chosen in line with the topic of the BEP project. Thus, the essay is always done parallel to the BEP project. For the theory part this is not compulsory, yet recommended.

In the first semester, team members often have more time due to fewer parallel courses. On an individual basis, teams can then decide to spend relatively more time on the BEP in Q1 than for just 3 EC; however, the general departmental flow cannot be adjusted accordingly.

2 Admission and start

To be admitted to the BEP, the student must have passed the first year of study and at least 54 EC of the second year. For the BEP in the first and second semester, the benchmark moment is the Wednesday of the second week, so that the exam results from the previous semester can be included.

In the first two weeks of the semester, there are no BEP-teams yet and there is time for lectures. We will give presentations from each of the ME research departments during this period; more about this in §9. The course coordinator of these lectures is dr. René Delfos. The lectures are not compulsory, but are highly recommended.

The structure of the project in weeks is as follows:

BEP SCHEME

Quarter	Week	Who	Activity
Q1&Q3	0	S	Last possibility to register in Osiris (~15 July / ~1 February)
Q1&Q3	1, 2	S	Opening BEP and information on Departments
Q1&Q3	2	S	Select preferred departments by students (+ potential team members)
Q1/Q3	1/2	CM	Benchmark moment. Final registration to BEP project
Q1/Q3	3	C	Team formation at department
Q1/Q3	3	D	First contact with supervisors
Q1&Q3	6	C	Interim colloquium 1 (varies per department)
Q2&Q4	2	S(+D)	Topic choice for essay Engineer & Society (in consultation with supervisor)
Q2&Q4	4 or 5	C	Interim colloquium 2 (varies per department)
Q2&Q4	8	S	Deadline paper submission (Friday at 14:00 the latest!)
Q2&Q4	9	C(+D)	Oral exam
Q2&Q4	10	C	BEP symposium

D = daily supervisor, C = BEP-coordinator department, CM = central management, S = student

See annual calendar at: <http://jaarindeling.tudelft.nl/>.

3 Organisation BEP

Departments

The BEP has a central management (CM), but most of the tasks and responsibilities lie in the departments. The CM is formed by the Director of Studies (René Delfos) and Onderwijsorganisatie-ME. Each department has its own BEP coordinator and also a certain freedom for its own colouring of the BEP.

Each department provides a sufficient number of BEP-project proposals *pro rata*, so that there is sufficient choice for the students. The departments preferably publish the project proposals as early as possible, so that the students have an idea of the activities in the departments.

Allocation

Each department is assigned a number of students. The number depends on the capacity of the department and is determined in advance in consultation. Among other things, other heavy educational tasks within the departments are taken into account. The projects are preferably defined for teams of four students.

Students register individually for the BEP in Osiris. Later, at the request of the CM in BrightSpace, they indicate their preference for the departments from one to seven and possibly for (a team of) fellow students. Preference may be based on subjects they find interesting, information about projects at the ME departments, websites and possibly information meetings. The CM distributes the students over the departments. Departments may be prepared to accept more team than others if there is great interest.

As soon as students are allocated to a department, they can indicate a preference for a project¹

¹ Students cannot pre-sort for a specific project 'in advance', but they can propose a project themselves – within ME or, for example, a company. There are conditions for this:

- The students do the project as a normal BEP group (of 4 people, but 3 or 5 is possible as well). The student is allowed to look for intended teammates – but in which each team member is further self-motivated, and equally responsible for his/her own and the group work. Only 'entire teams' can propose their own 'own' project.
- The project – even if at a company – is supervised by a staff member of ME. The research and/or design falls

in consultation with the BEP coordinator of the department and foursomes are created. The team formation and project distribution is completed at the end of week 3.

Supervisor

The formed teams work under the supervision of a daily supervisor who is a member of the scientific staff of the relevant department. The BEP coordinator of the associated department (see below) arranges the division into teams and the assignment to daily supervisors.

4 Working method

In the first two weeks, students get a series of seven short one-hour information lecture from all research departments of ME about mechanical engineering research and specific themes of the department, in order to be able to make informed choices for their preferences.

Per department

Within the department there is also the possibility to add a department-specific component, such as lectures on research or design methodology often applied within the department, or guest speakers from a company.

A daily supervisor can supervise a maximum of two BEP teams and may involve their own PhD students or postdocs in the supervision, so that the BEP teams can participate in active and current research projects. The coordinator encourages in particular the permanent professors and TenureTrackers/ACT-ers with an ME Cohesion Grant to submit project proposals.

Projects

The projects contain one or more elements of the CDIO process: Conceive, Design, Implement, Operate and Test, and will often (partly) take place in one of the ME labs. Assignments can be more theoretical or carried out at a company, provided that the responsibility remains with the daily supervisor of the ME. In terms of content, the projects flow logically from the research in the departments involved; the required knowledge and skills are in the field of the Bachelor Mechanical Engineering.

Content

The BEP teams work together on a final assignment of 14 EC (almost 400 hours) per person. The individual component is determined "halfway through the turnaround time" in the form of a division of tasks in consultation with the team and the daily supervisor. This can take various forms, for example, individual measurements, analyses, design calculations, simulations, etc.

The teams write a joint paper or report of 4-10 pages; the exact number determines the department coordinator. In addition, the teams build a dossier with, for example, a logbook, collected literature, measured values, technical drawings, written code and results from simulation software.

The file also offers room for a reflection section of each student on her/his own performance and that of the fellow team members. The paper or report and dossier are archived electronically by the department.

under the research area of the ME supervisor; the CL can suggest possible supervisor(s), but these can of course also say no when asked; and has to judge for himself or with help of the coordinator whether it is a suitable subject for him/her, or adjust it.

- The team regularly participates in the BEP process of the ME Research Department of the supervisor, so with interim colloquia / presentations / peer reviews, specialist lectures etc.
- The team also works in ME (part of the time) at a project table and/or in the (departmental) laboratory.
- If IP matters are concerned – when an external party is involved – this is done via the contract office of ME.

Colloquia

The BEP coordinator organises regular colloquia in which all BEP teams of the department participate and where intermediate results are presented. It can be desirable within a department to keep certain projects confidential. This can be done by means of an NDA-form. The aim of the colloquia is to learn how to present, being able to present results well is an important element in professional life and when graduating.

5 BEP-coordinators

Each department appoints a BEP coordinator from its staff. The coordinator has the following tasks:

- Ensure that sufficient² projects are available from the department per semester, ensure that the projects fit sufficiently within the BSc-Wb curriculum, and ensure that the projects are sufficiently "new".
- Welcome the teams in the department, enable contact with the supervisors including the support staff, provide for example safety instructions for the labs, and organise midterm colloquia and a BEP symposium.
- Provide interim supervision of the students and the project (&daily) supervisors. This could be established by an interim meeting with the BEP teams to monitor whether the supervision still is fine, and a plenary meeting with all project (&daily) supervisors
- Help the teams finding workspace in or near the (departmental) laboratory. In any case, the teams are entitled to at least two dayparts per week at the general ME-project tables.
- Determine how many pages the paper / report should have (between 4 and 10), and in what format a research file should be drawn up.
- Put together a 'BEP exam committee'.
- Determine whether the presentations at the BEP symposium should be in Dutch or, according to the team's choice, in English or Dutch.
- Provide funding for materials. Each team is entitled to at least €150 for small expenses.
- Together with the departmental secretariat, take care of the archiving of the BGR's (see §8), the papers and the eventual dossiers.

The current BEP-coordinators are:

Department	Names
BMechE	Behrooz Fereidoonzhad
CoR	Hans Hellendoorn and Ellen Driessen
DCSC	Max Mendel and Matthijs van Raaij
M&TT	Mark Duinkerken
MSE	Poulumi Dey and Iref Joeman
P&E	Willem Haverkort
PME	Gerard Verbiest
O&S (CM)	René Delfos, Esther Kroes, Linda van der Hout

6 Tasks of project supervisor

Each team has a daily supervisor, a member of the academic staff of the department, possibly supported by a PhD student or Postdoc as daily supervisor. The tasks of the project supervisor are:

- Meet weekly with the team (and daily supervisor).

² 'Sufficient' is a few projects more than necessary, so that there is really a choice for the teams.

- Help the team formulate the problem.
- Point the team to relevant publications for the scientific literature.
- Support in carrying out the work, e.g., developing a test setup or finding test subjects if applicable.
- Actively contribute to the essay topic in relation to the Engineer & Society course.
- Preferably practice with the team before the presentations, or at least comment on the slides in advance and evaluate the presentation afterwards.
- Pay attention to the function of the team: who does more, who does less; manage the team.
- Agree with the team whether the report and the presentations should be in Dutch or English.
- After the oral exam, give the team feedback on the partial grades based on the completed Grading Rubric.

7 Oral exam and BEP symposia

In week 9 or at the beginning of week 10 of the semester, an oral exam takes place per team. The assessment committee consists of at least three members: the daily supervisor, two members of the academic staff, where one may be replaced by an involved PhD-student, postdoc or junior teacher. The committee stems from different sections or chairs of the department. The BEP coordinator approves the committee.

The oral exam consists of an examination of 45-60 min, the length is determined by the BEP coordinator. It is desirable to start with a technical presentation of approx. 10 min, the session can be in English or Dutch, the BEP coordinator decides on this. After the team exam (or possibly a series of exams) the committee determines the grades based on the BEP Grading Rubric. The partial grades are communicated to the team after a reasonable time, and count for 25% (Process), 45% (Paper), and 20% (Defense) towards the final grade.

At the end of week 10 of the semester, a BEP symposium will be held *per department*³. Family is welcome at this meeting, and each team gives a presentation that is accessible to family, fellow students, and supervisors. A panel of staff members from the associated department will grade the presentation. This mark counts for 10% towards the final mark. The department invites the dean, the director of education and the BEP central management to this symposium.

8 Final grade

We use the "BEP Grading Rubric" (BGR) for the assessment of the BEP. A BGR is filled in individually for each student. The BGR consists of five parts: Process (25%), Paper (45%), Defense (20%), and Presentation (10%).

The Process throughout the semester is established by the daily supervisor(s), for which students receive an individual assessment by assessing the following criteria:

- Acquisition and application of new knowledge
- Critical attitude
- Responsibility
- Teamwork

³ In the first semester, midterm colloquia and the final symposia will be combined, if possible, per two departments in order to create sufficient body and opportunity for peer feedback between the different BEP teams.

- Research/design performance

In order to be able to differentiate between the different team members, the supervisor can make use of his own impression, but also of the reflection as included in the Dossier, or results following from Buddycheck.

The Paper is assessed by the committee before or after the oral exam, the assessment applies to the entire team and is based on the following criteria:

- Literature
- Structure
- Justification
- Application of research- & design methodology
- Research/design significance
- Application of BSc knowledge

The defense is also assessed by the committee *directly after the oral exam*, but the assessment is individual. The following criteria are used:

- Defense
- Critical attitude
- Application of BSc knowledge

Finally, the team receives an assessment for the Presentation at the BEP department symposium. The following criteria are used for the presentation:

- Communication
- Level of argumentation

As for any presentation, the Golden Rule holds: 1/3 should be accessible for interested audience (like parents), 1/3 for your peers (fellow Wb-students) and 1/3 for experts in the field. To determine the final mark of the BEP, we use the grades from the BGR. The partial grades are stored and collected by the CM and made available to students in Brightspace (via the Gradebook). The CM applies a grade correction to level different gradings between the different departments. And finally uploads the final BEP-mark in Osiris.

The BEP coordinator determines which team has given the best presentation at the BEP department symposium and presents a "Best presentation award" for this. The seven best teams will be nominated to present their project during the Bachelor graduation ceremony, the CM will determine the two or three teams that are eligible.

9 Research departments

Introduction

By organisation, a university faculty consists of various research departments, which jointly provide several educational programs (B.Sc. and M.Sc.). ME currently has seven departments and, in addition to Mechanical Engineering (Werktuigbouwkunde), two smaller Bachelor's degree programmes, but none of this is static. Over the years, researchers or entire research groups change departments or even faculty. And new courses, and sometimes programs appear or disappear. Of course, this is related to internal strategic decisions and external management – socially relevant themes also change over time. A so-called Spot Plan is currently being implemented within ME, whereby various laboratories are moving physically.

Approach

We want to show in the first two weeks that the different departments also have different colours and that each contribute in their own way to mechanical education and research. During one lecture hour,

each department presents how they conduct research and how this fits in with the BSc-Mechanical Engineering. It is about the practice of the research; what problems are encountered. We also want to make it clear that at least 50% of the staff's time and effort is spent on research. In addition to working hard in the lab or behind a desk, research also includes writing articles, attending conferences and participating in (inter)national research projects. We want to show that doing research is intensive and requires a rather stubborn attitude. Scientists often look for one thing and find another. Out-of-the-box ideas often only arise after a long and intensive search for solutions. We want to explain to students what literature research is, which sources are available and how you should approach those sources – critically! It is precisely at ME that we want to show that research into fluid mechanics requires very different competences than research into human behaviour in relation to machines, and that working with mathematical models is very different from designing advanced equipment. We also want to discuss the risks of working with simulations, working with people and human models, working with scale sizes and working in large-scale processes. Measurement, retaining data, use of software packages, dealing with systematic errors and significance, etc. should also be discussed.

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