Aalto University

Computational Engineering

SCI-A1010: Research and Academia

Luc St-Pierre

06/10/2022

Today

- Learn about the main MSc programmes offered at the School of Engineering.

- Remember that by completing your BSc in Computational Engineering you can automatically continue your studies in one of these MSc programmes.

- More information here: https://into.aalto.fi/display/enbsctech

Three options after your BSc

1. **Continue to a MSc programme at the School of Engineering.**
   - No pre-requisites (in terms of minor/electives).
   - Four programmes that will be introduced today.

2. **Continue to a MSc programme at a different School.**
   - Usually requires a specific minor.
   - All conditions are detailed on Into, click here.

3. **Continue at a different university.**
   - Separate admission process.

Older students : "I wish I had paid attention to this earlier!"

Program

14.25 MSc in Building Technology

- *Prof Gerhard Fink*

14.45 MSc in Mechanical Engineering

- *Prof Jukka Tuhkuri*

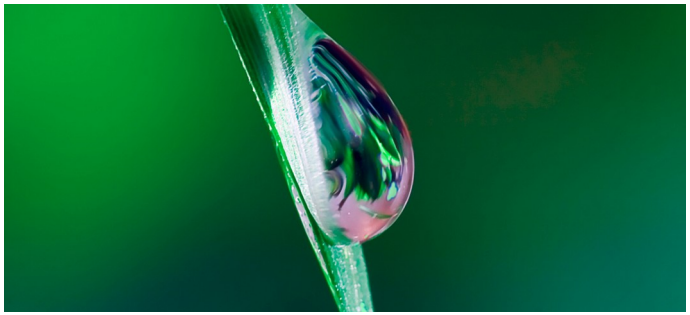
15.05 Break

15.15 MSc in Geoengineering

- *Prof Mikael Rinne*

15.35 MSc in Advanced Energy Solutions

- *Prof Ville Vuorinen*



Program: Advanced Energy Solutions

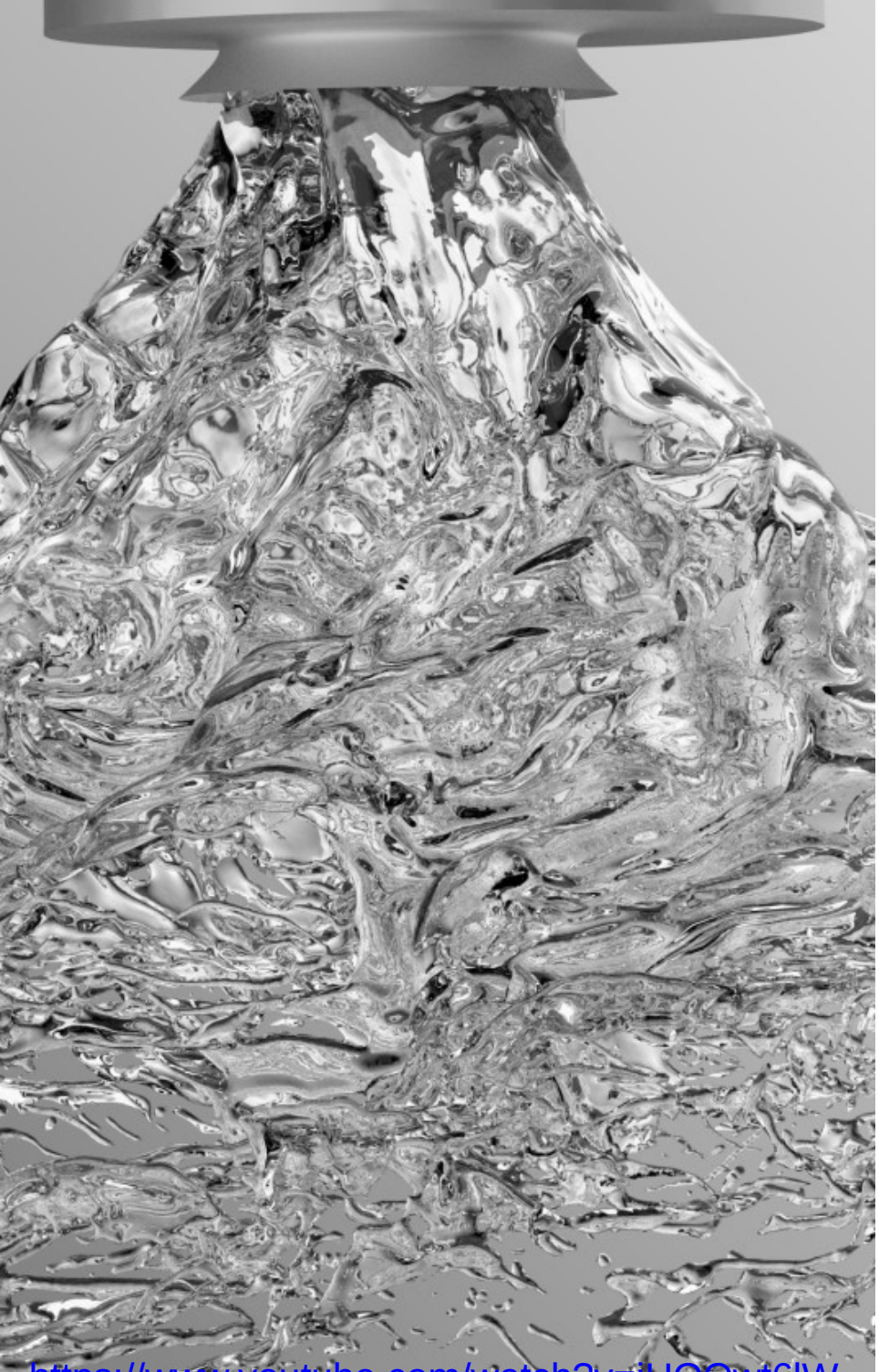
Example major: Energy Conversion Processes

Prof. Ville Vuorinen, Professor in Charge for SEC major
Prof. Ossi Kaario
Aalto University, School of Engineering
Oct. 6th 2022
ville.vuorinen@aalto.fi

Aalto University
School of Engineering

The EU is committed to a carbon neutral Europe by 2050, while Finland's respective target is already in 2035.

To reach this goal, energy conversion processes need to be designed, re-designed or improved and understood ***based on natural sciences and interaction between different disciplines****.*



https://www.youtube.com/watch?v=jUOQwt6lWS8
https://www.youtube.com/watch?v=ZaLXwR_D7c

Energy Conversion Group at Aalto (5 prof. + 45 researchers)

1) Carbon neutral energy

2) Energy storage into fuels and chemical compounds

3) Clean combustion

4) Computational fluid dynamics

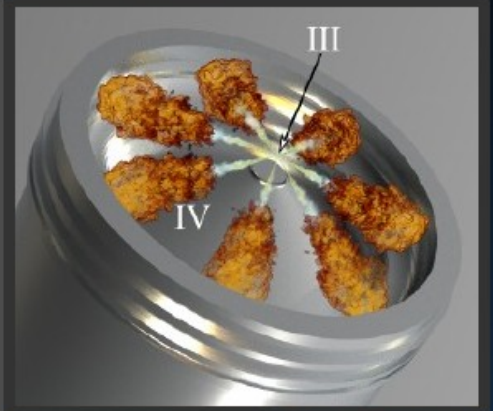
Figure: Simulation of biofuel injection
E.Laurila, V.Vuorinen et al. Int.J.Multiphase Flow (2019)

Fluid dynamics: Broad range of applications

Reference: https://pof.tnw.utwente.nl/research/turbulencebubbles/windles

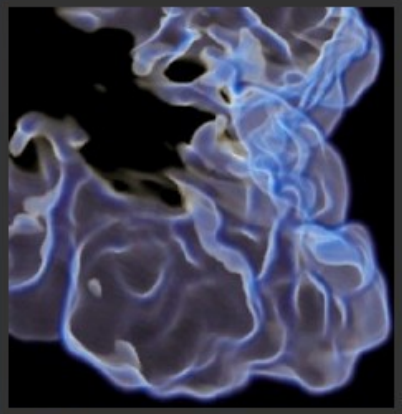
Prof. V.Vuorinen CFD team's competence: Scale-resolved fluid dynamics simulations, reactive flow, heat transfer, spray assisted multi-fuel ignition, multiphase flow.

Non-premixed sprays (LES+FGM)



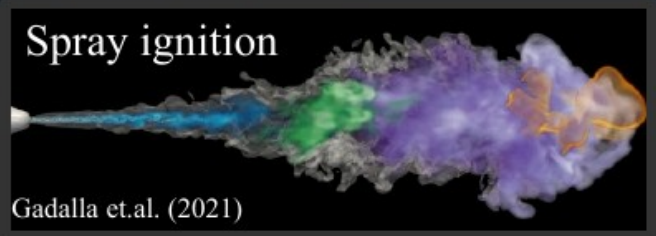
Kahila et al. (2018)

Premixed flames (LES+G-eqn)



Ghaderi et.al. (2018)

Non-premixed, Tri-/dual-fuel (LES+finite rate chem.)

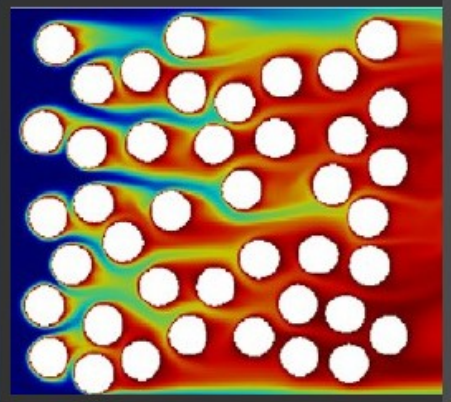


Gadalla et.al. (2021)

DLBFoam

Morev et al. (2022)

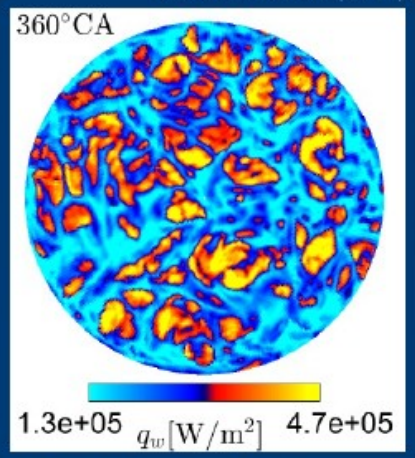
Methanol &P2X (DNS)



Izbassarov et al. (2021)

2016 — 2018 — 2021 — Year

Keskinen et al. (2018)

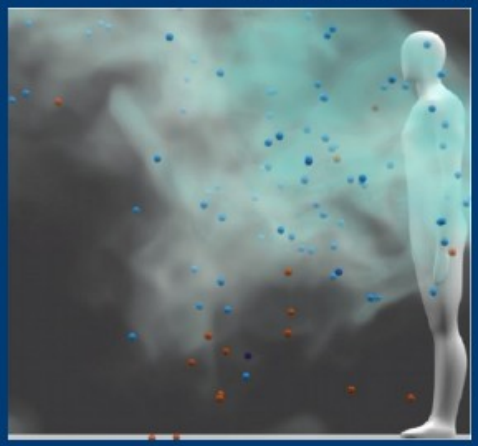


Heat transfer (LES+novel wall models)

Laurila et al. (2019)

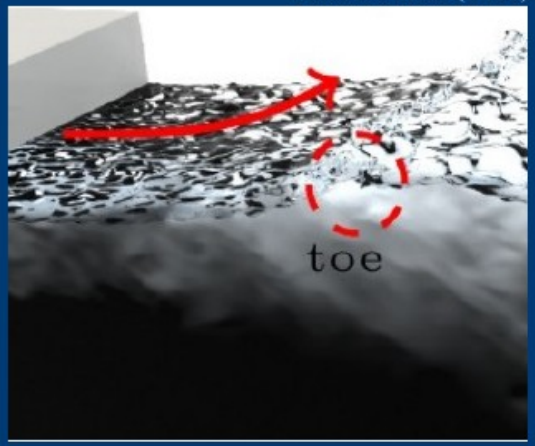
Biofuel atomization (LES+VOF)

Vuorinen et al. (2020)



Airborne virus & COVID-19 (DNS)

Peltonen et al. (2021)



Marine hydrodynamics (LES/DES/RANS+VOF)

Wind power in Finland

Frontpage > Wind power in Finland > Wind power in Finland > **About wind power in Finland**

About wind power in Finland

In Finland, wind power construction began later than in many other European countries. However, from 2012 to 2013, wind power construction has gained momentum and national construction and production statistics have been broken year after year.

At the end of 2019, there were 754 installed wind turbine generators, with a combined capacity of 2284 MW. They generated 7 % of Finland's electricity consumption in 2019.

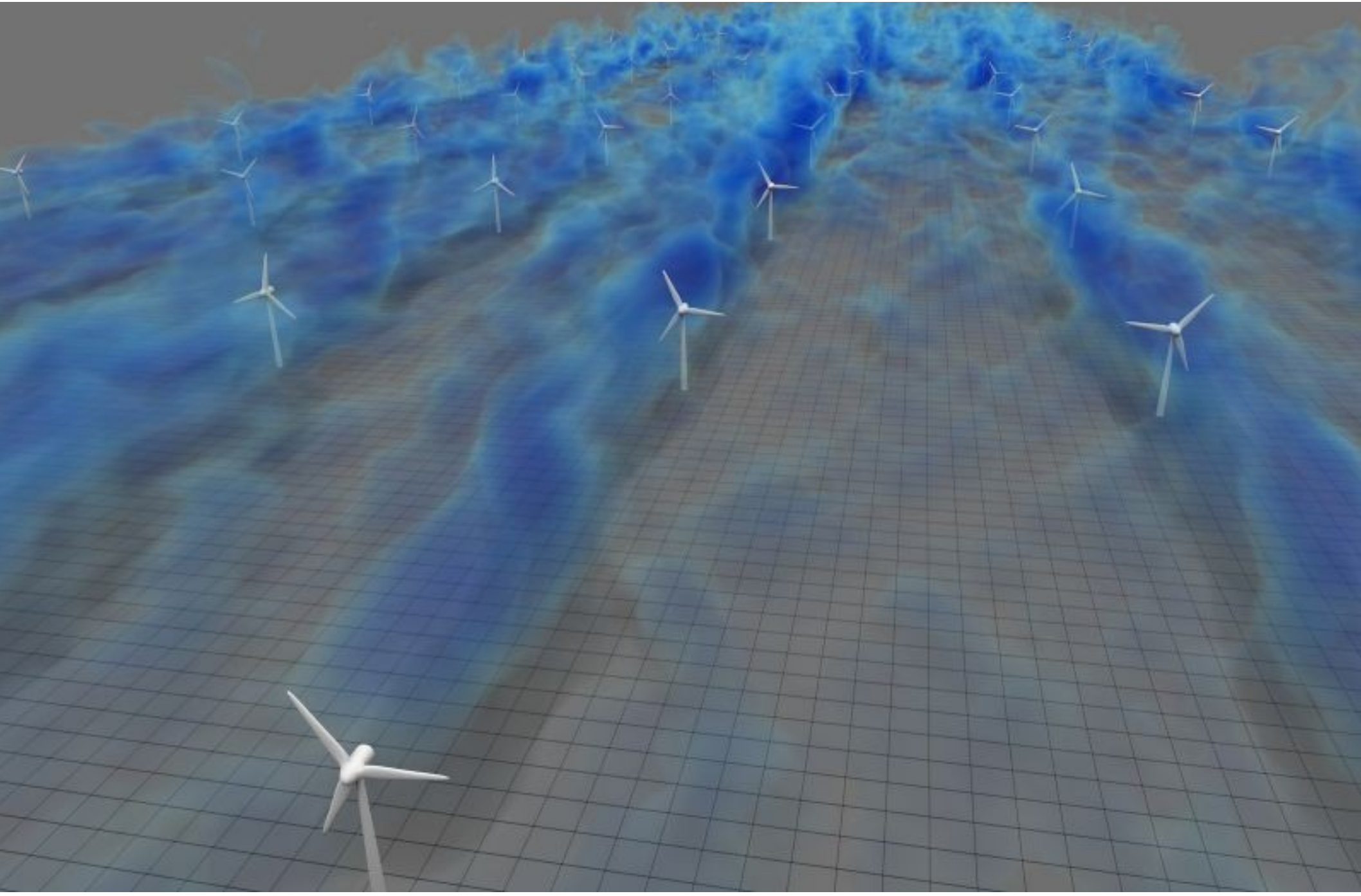
2284 MW

In 2019, there were 754 installed wind turbine generators, with a compined capacity of 2284 MW.

30 TWh by 2030

Fluid dynamics: CFD simulation of a wind park

Reference: https://pof.tnw.utwente.nl/research/turbulencebubbles/windles



Green hydrogen

https://p2x.fi/en/

P2X News Project Team Contact Us Suomi

P2X solutions

We change the world to become cleaner – together

Producer of green hydrogen and forerunner of Power-to-X technology in Finland

As a developer of emission-free welfare society we are a forerunner of energy future – our vision is to produce green hydrogen and refine it further into synthetic fuels in a cost-effective manner

Fluid dynamics, heat transfer, combustion and thermodynamics: Crucial to many industries e.g. Wärtsilä's marine engine products operating on carbon free fuels (**<u>ammonia, hydrogen</u>**). **Below:** Smart Technology Hub in Vaasa

Heat transfer/fluid dynamics: M.Sc. thesis work on energy storage in 5G smartpoles (Business Finland and Nokia),

A.Lagerström, Experimental study on a new latent heat storage system, M.Sc. Thesis, Aalto 2021

Heat transfer/fluid dynamics: M.Sc. thesis work on energy storage in 5G smartpoles (Business Finland and Nokia),

A.Lagerström, Experimental study on a new latent heat storage system, M.Sc. Thesis, Aalto 2021

Figure 2: Overview of Kera area ecosystem and its components. Smart poles will also be located in this environment. (Visuals made of Aalto University Design Factory team)

Heat transfer/fluid dynamics: M.Sc. thesis work on energy storage in 5G smartpoles (Business Finland and Nokia),

A.Lagerström, Experimental study on a new latent heat storage system, M.Sc. Thesis, Aalto 2021

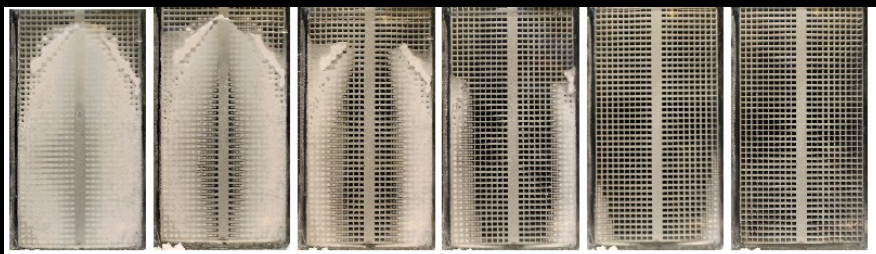


Figure 21: Melting of PCA28 documented with a 4 minute interval

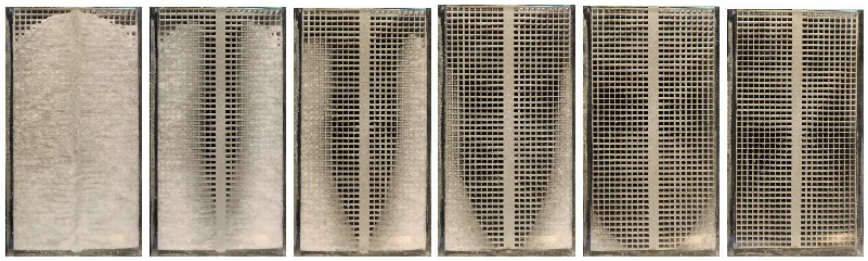
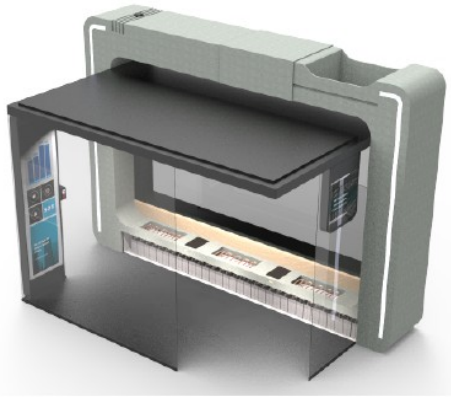
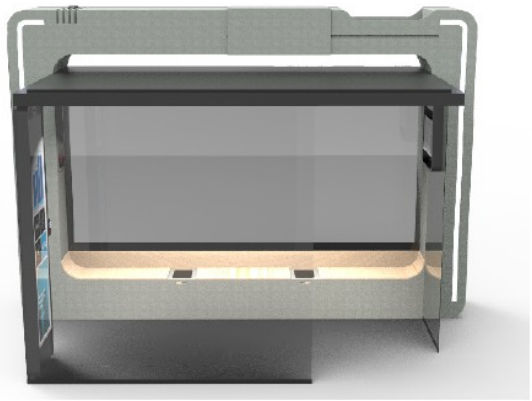


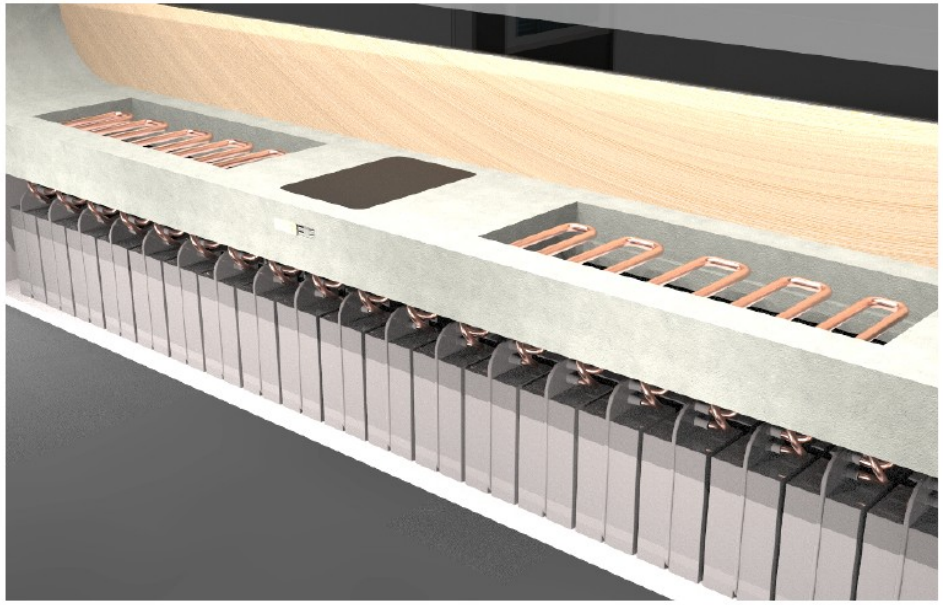
Figure 22: Melting of decanoic acid documented with a 4 minute interval



(a) Open bench to view the inside structure



(b) Normal view, hidden structure



(c) Close up view, bench surface and storage tank walls missing

Figure 37: LHTES bench heating concept for a smart bus stop. Visualizations made by Aalto Univeristy Design Factory team

Major: Energy conversion processes

Science based solutions:
Mathematics, Physics, Chemistry, IT →
Fluid Dynamics, Thermodynamics, Heat transfer →
Computational Fluid Dynamics, Process Simulation, Modeling, Experiments, Optimization...

Flexibility in major studies:
Mandatory 36 ECTS
Advanced studies 30 ECTS divided into logical study paths

Rough outline of EC major

The major studies (66 cr) are divided into:

Compulsory: programme common courses (16 cr), major common courses (20 cr)

Advanced studies: (30 cr).

Example study paths:

1) Conversion and Storage, 2) Methods and 3) Systems and Technologies.

Learning outcomes

1) Natural phenomena and energy

2) Holistic view on energy systems

3) Analysis and evaluation skills

4) Use science for sustainability

The idea of the study paths is to show the students what kind of career options would be possible from this major, and what kind of courses would be useful in obtaining the required core competence. For all study paths, all AAE students will take the following courses, in total 16 credits.

AAE-E1000	Introduction to Advanced Energy Solutions	I-II	1. year
ELEC-E8422	An Introduction to Electric Energy	I-II	1. year
31C01300	Energy and Environmental Economics	V	1. year

The following Major Common courses, in Sustainable Energy Conversion major are mandatory for everyone, 20 credits.

MEC-E1020	Fluid Dynamics	I	1.year
EEN-E1020	Heat Transfer	II	1.year
EEN-E1030	Thermodynamics in Energy Technology	I-II	1.year
AAE-E2005	Thermochemical Energy Conversion L	III-IV	1.year

These above-mentioned courses form a solid basis for three different study paths, introduced below.

Study path: Conversion and Storage

The Conversion and Storage study path is aimed at students who are keen on understanding different processes in energy conversion and storage technologies, especially renewable energy. Students who study this path will become experts able to work in the energy and process industry as technical experts. This study path provides a deep understanding of the processes and gain an ability to improve process operation, maximize process efficiencies and to understand theoretical limitations. A typical job in Finland would be in energy companies such as Fortum, ST1 or Helen.

AAE-E3090	Renewable Energy Engineering	III-IV	1. year
CHEM-E4255	Electrochemical Energy Converion	II	1. or 2. year
AAE-E3100	Energy Carriers L	I	2. year
AAE-E3070	Electrical Energy Storage Systems L	IV-V	1. year
AAE-E3080	Thermal Energy Storage Systems L	I	2. year
AAE-E3120	Circular Economy for Energy Storage L	I-II	2. year
EEN-E1040	Measurement and Control of Energy Systems	I-II	1. or 2. year
EEN-E3002	Power Process Simulation	I-IV	1. year
EEN-E3005	Exercises in Energy Technology	I-V	1. or 2. year
AAE-E3000	Advanced Energy Project	I-II	2. year

Study path: Methods

The Methods study path is aimed at students who are motivated in learning concrete R&D design using experimental and/or simulation methods. The students learn various measurement and simulation methods applying fluid dynamics, heat transfer and thermodynamics in practice. The study path enables R&D work in industry or research. For example, the path offers a possibility to become an expert in the emerging R&D topics involving energy process simulation and CFD modeling. A typical career opportunity in Finland would be in simulation companies such as Elomatic, Universities, VTT, and boiler and component manufacturers such as Andritz, Valmet, Oilon and Sumitomo Foster Wheeler.

EEN-E1040	Measurement and Control of Energy Systems	I-II	1. or 2. year
EEN-E3002	Power Process Simulation	IV-V	1. year
EEN-E2001	Computational Fluid Dynamics	III-IV	1. year
AAE-E3030	Numerical Modelling of Multiphase Flows	IV-V	1. year
MEC-E2010	Computational Fluid Modelling L	I-II	2. year
EEN-E2004	Mass Transfer	III-IV	1. year
CHEM-E7190	Process Dynamics and Control P	II	2. year
CHEM-E6115	Thermodynamics of Modeling and Simulation	III-IV	1. year
EEN-E3005	Excercises in Energy Technology	I-V	1. or 2. year

Study path: Systems and Technologies

The Systems and Technologies study path is a perfect fit for a student who wants to work on developing and analyzing renewable technologies, and understand the operation of power plants, factories and energy systems as a whole. It is possible to become an expert in wind, solar or bioenergy applications. A typical job in Finland would be in renewable energy companies such as ST1 or Helen. There is a high demand for R&D experts on wind and solar power installations in various SME's. Also, developers for other sustainable bioenergy applications are constantly needed.

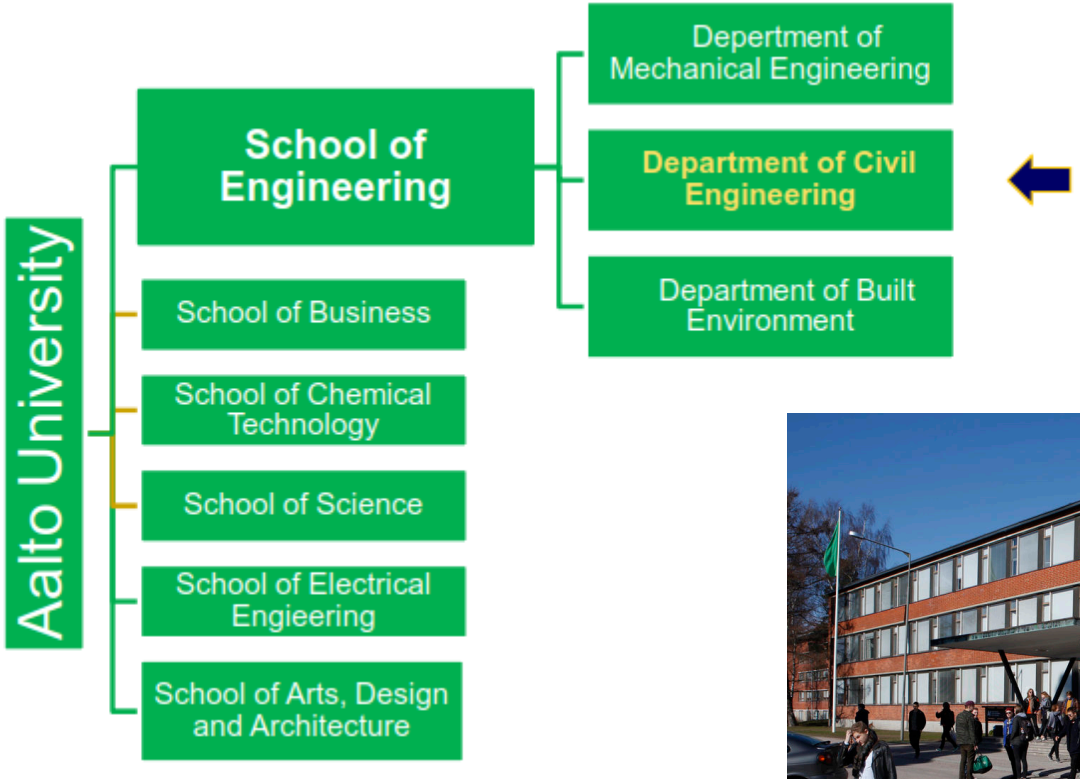
AAE-E3090	Renewable Energy Engineering	III-IV	1. year
CHEM-E1100	Plant Biomass	I-II	2. year
EEN-E1010	Power Plants and Processes	I-II	1. or 2. year
EEN-E3006	Energy Markets	I	1. or 2. year
PHYS-E0483	Advances in New Energy Technologies	III-IV	1. year
PHYS-E6570	Solar Energy Engineering	III-IV*	1. or 2. year
PHYS-E6571	Fuel Cells and Hydrogen Technology	III-IV*	1. or 2. year
PHYS-E6572	Advanced Wind Power Technology	I-II*	1. or 2. year
21E16100	Energy Business and Innovation	V	1. year
EEN-E3005	Excercises in Energy Technology	I-V	1. or 2. year
AAE-E3000	Advanced Energy Project	I-II	2. year

Aalto University

Aalto University
School of Engineering

Building Technology Master’s programme!

Department of Civil Engineering



Aalto-yliopisto
Aalto-universitetet
Aalto University

Aalto BSc in Engineering
with major in Structural and Mechanical Engineering

Aalto BSc in Computational Engineering

BSc from outside Aalto in Finland, for example UAS

BSc from outside Finland

Master's programmes in School of ENG
Advanced Energy Solutions (AAE)
Building Technology (CIV)
Geoengineering (GEO)
Geoinformatics (GIS)
International Design Business Management (IDBM ENG)
Mechanical Engineering (MEC)
Real Estate Economics (REC)
Spatial Planning and Transportation Engineering (SPT)
Urban Studies and Planning (USP)
Water and Environmental Engineering (WAT)

CIV: Students starting 2022

50 students from Aalto ENG Bachelor program

34 students coming from outside Aalto

- Different nationalities
- BSc degree from Finnish polytechnics/universities

Exchange students

Building Technology Master's programme (CIV)

- Degree: Master of Science (Technology)
- Size: 120 ETCS
- Duration: 2 years full-time
- Language: English
- Organizer: Department of Civil Engineering

Building Technology Master's programme (CIV)

- Creating safe and healthy built environments
- Combining the global needs for energy efficiency and sustainability with the characteristics of a good living environment

Building Technology Master's programme (CIV)

The programme deals with

- **Design**
- **Construction**
- **Use and maintenance of civil engineering structures, such as buildings and bridges**

The programme involves

- **Structural engineering**
- **Building performance**
- **Construction management**
- **Production and maintenance**
- **Structures and architecture**

Professional knowledge and skills

… for the future careers in **industry**, **research**, **education** or **authority**.

Based on the individual selections, the students can learn:

- Strong skills in design, construction, use, and maintenance of complex civil engineering structures, such as buildings and bridges
- Extensive analytical skills to evaluate impacts and efficacy of different propositions: e.g. the functionality, lifecycle and sustainability of buildings and structures
- A visionary and proactive mindset to lead and manage various engineering projects: e.g. management and communication skills to enhance collaboration between experts
- An in-built sustainable approach to their profession: wellbeing of environment, society and people as the starting point for successful civil and structural engineering

Working life skills

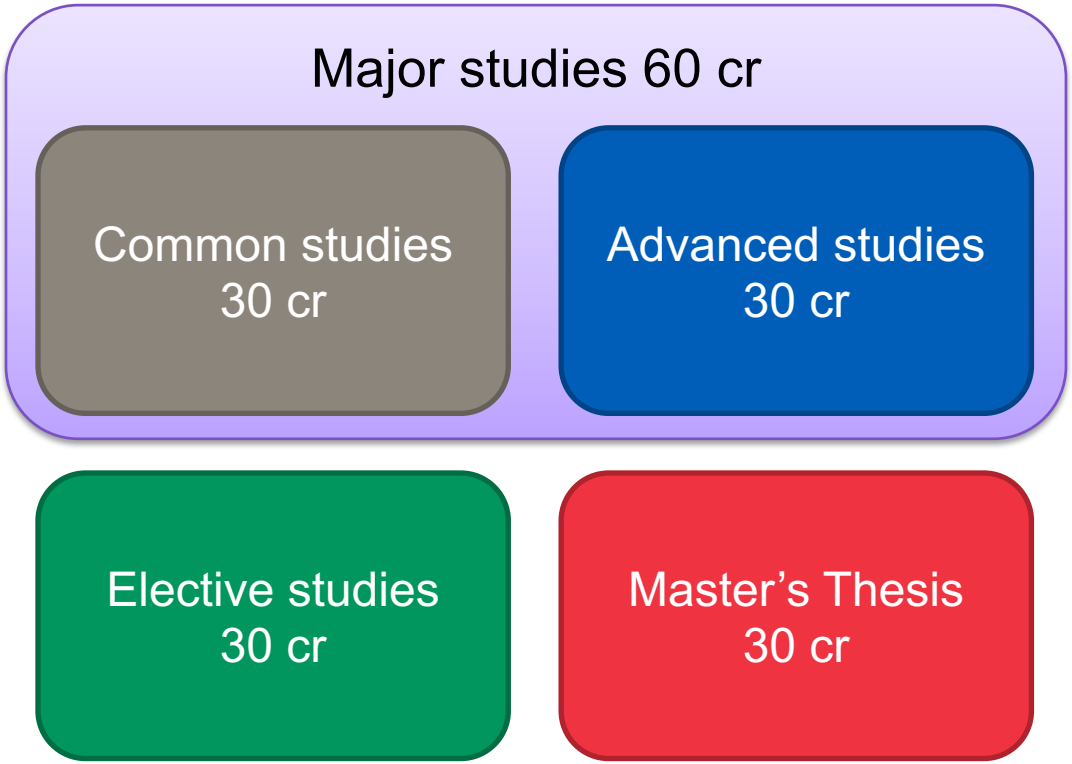
- **Analytical, logical and critical thinking**
- **Creative problem solving**
- **Multidisciplinary teamwork and collaboration**
- **Communication for scientific and technical professionals**

The aspects of **professional ethics** and **social and environmental responsibility** are integrated into the education of the programme.

Sustainable development goals (SDGs)

Closest to Building Technology

Master’s degree 120 cr



Major subject

- **BuildingTechnology Master's programme has only one Major subject: Building Technology.**

- **We do not provide minors for our own students.**

Study paths

https://into.aalto.fi/display/enciv/Study+Paths

- Aging Management of Structures
- Analysis and Simulation in Civil Engineering
- Bridge Engineering
- Building Physics
- Construction Management
- Design of Concrete Structures
- Design of Steel Structures
- Design of Wooden Structures
- Fire Safety Engineering
- Indoor Environment

Geoengineering

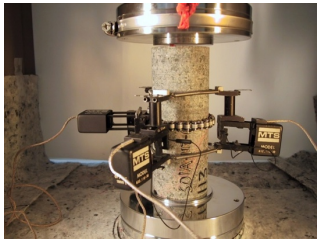
Aalto-yliopisto
Aalto-universitetet
Aalto University

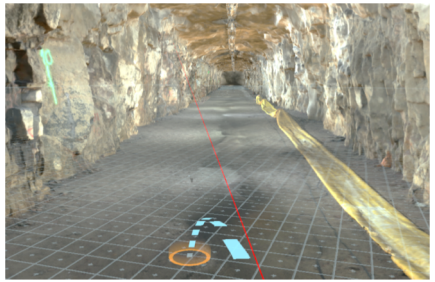
Mikael Rinne / Wojtek Solowski

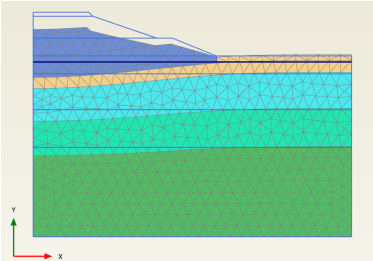
6.10.2022

Geoengineering at Aalto

- Focus in geomaterials, mechanics and construction.
- Significant part of built infrastructure: foundations, roads, tunnels and mining.
- Entire life cycle of the geotechnical structure: research - design - construction - maintenance - recycling.





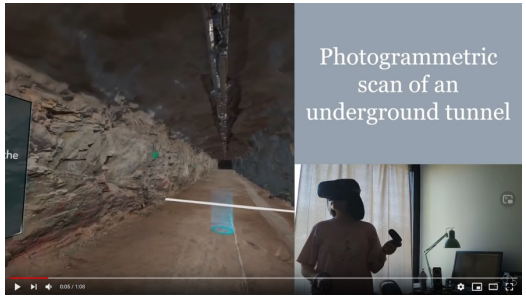


Aalto U
Schoo

Geoengineering

- **Excellent job prospects**
- **World class education**
- **Exceptional community**

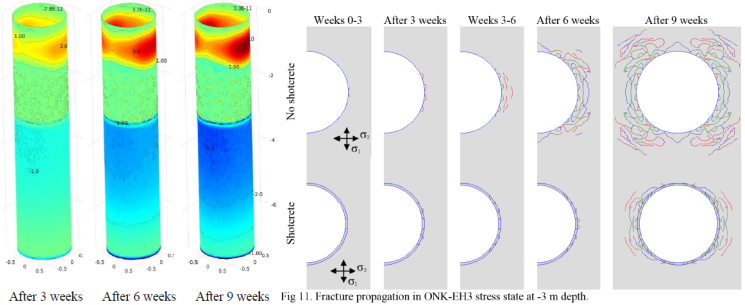
Research tunnel under Aalto campus



VR applications

https://youtu.be/fmIIp5T9fQA

Continuum and Discontinuum methods for modelling



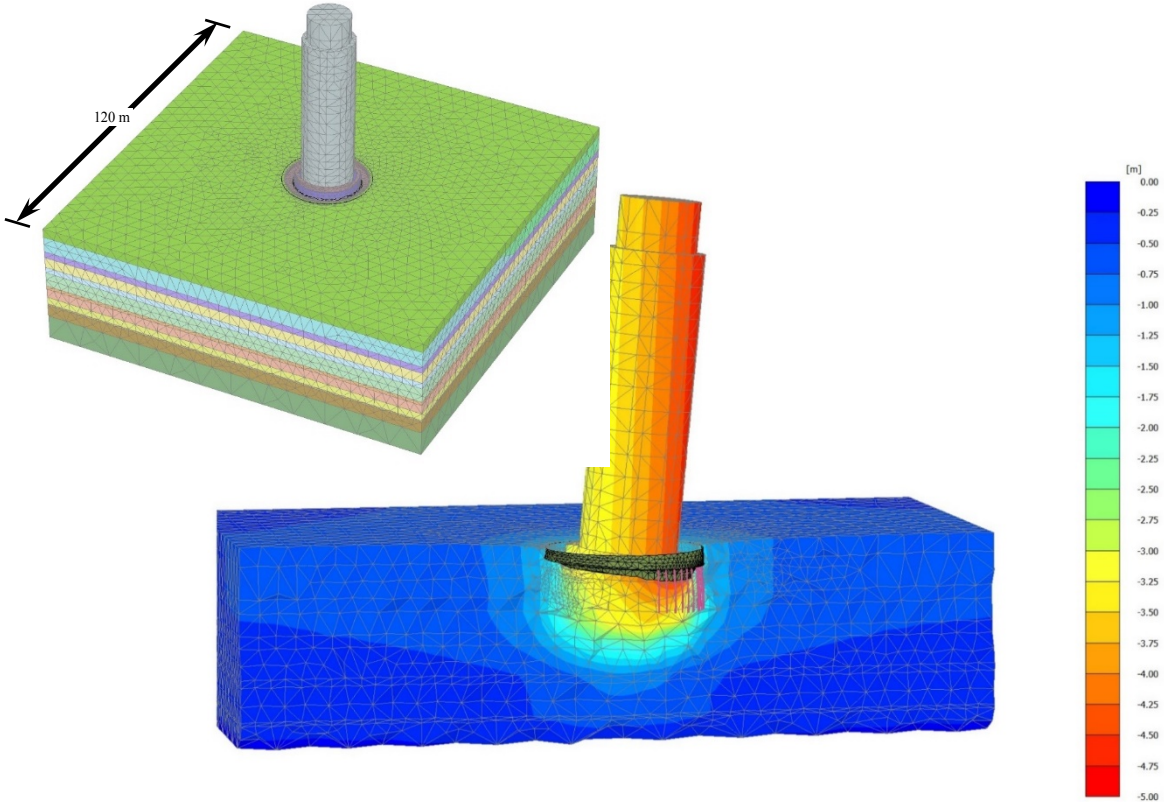
Laboratory facilities to verify numerical models

Aalto-yliopisto
Insinööritieteiden
korkeakoulu

Challenges

Wojciech Sołowski

Behaviour of complex engineering structures

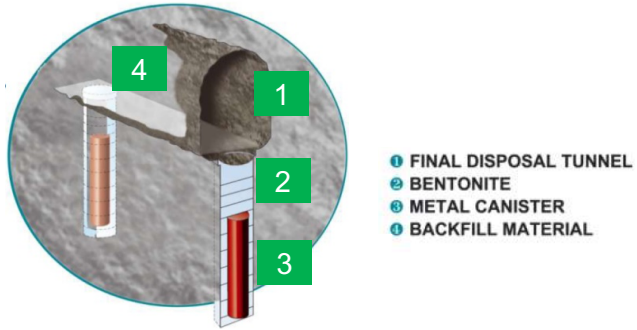


3D modelling of the deformation history of Pisa Tower and future predictions

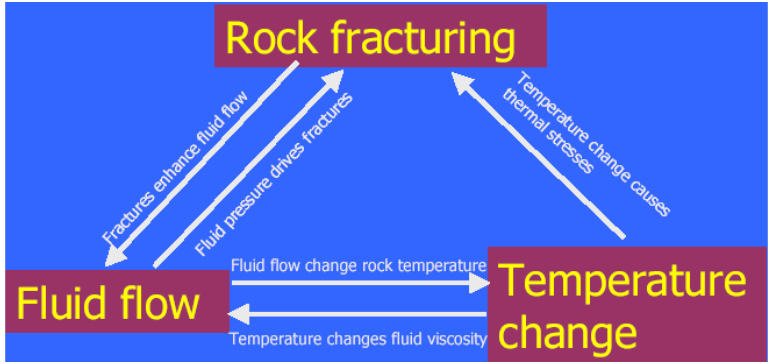
Safety of nuclear waste storage

Figures:
www.posiva.fi

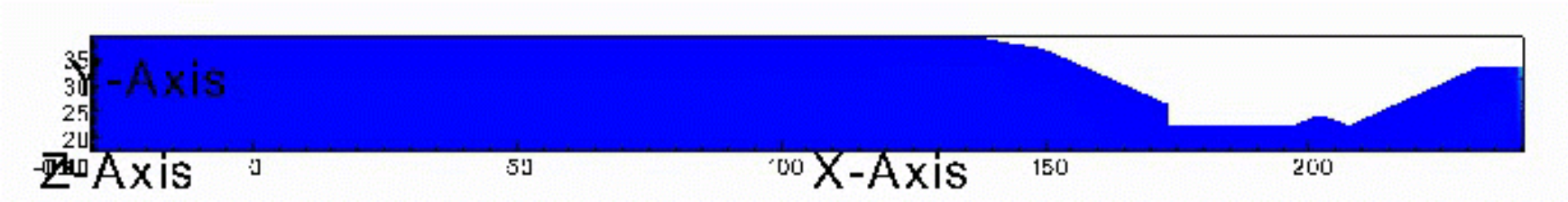
Finland is most likely the first country to start final disposal of spent nuclear fuel (2025).



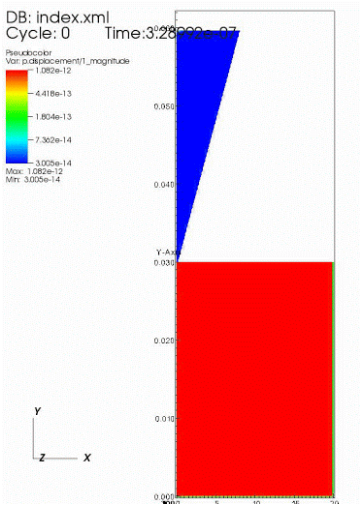
Safety analysis requires complex modelling of the behavior of engineered and geological structures.



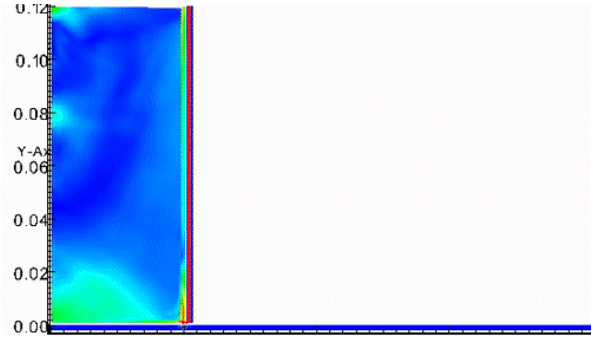
Landslides and large deformations analyses



St. Monique Landslide simulation

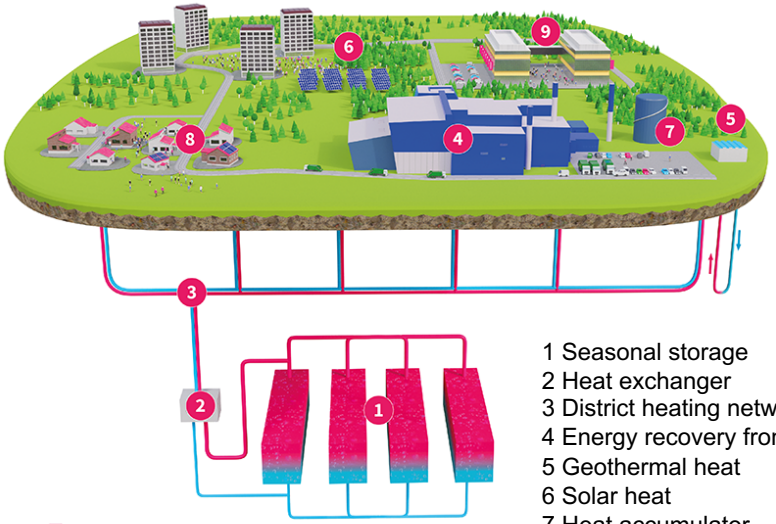


Fall cone test



Quickness test

Challenge: Heat storage

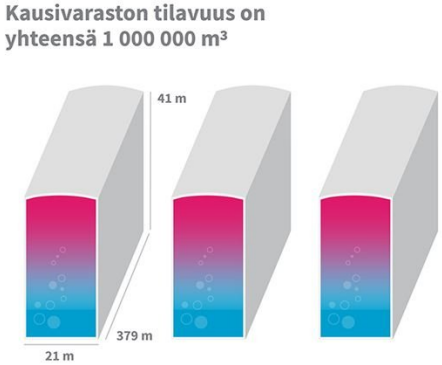


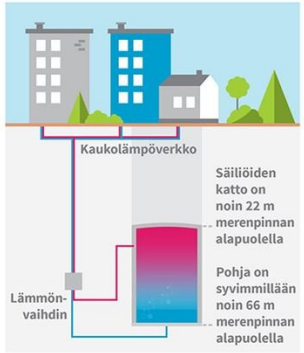
Vantaan Energia

1 Seasonal storage
2 Heat exchanger
3 District heating network
4 Energy recovery from waste
5 Geothermal heat
6 Solar heat
7 Heat accumulator
8 Combined cold and heat production
9 Waste heat recovery

https://www.vantaanenergia.fi/lampoverkko-on-ilmastoystavallisen-energian-jakelukanava/

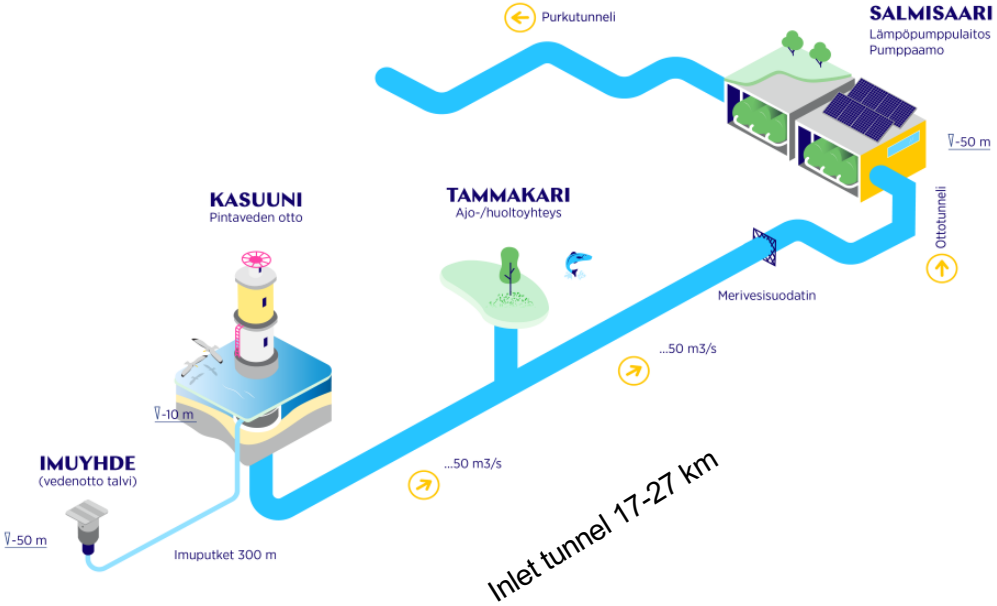
- High water storage temperature, 140°C => high thermal expansion & high rock stress & deformations
- Volume ~ 1Mm^3
- Capacity 90 GWh / corresponding 65´000 t CO_2-equiv./year
- Scheduled to be commissioned in 2026.





Challenge: Seawater heat recovery

To replace Salmisaari district heat plant (coal) in Helsinki



- To replace Salmisaari district heat plant (coal) in Helsinki
- To locate the heat pump plant in existing energy production underground facilities.
- Based on year-round use of seawater.
- Requires seawater of at least + 2°C heat source (coldest season).
- Requires a seawater intake far away from plant (tunnel)
- Outside the winter, the shore closer to the intake of warmer surface water is used
- The development is scheduled to begin 2022.

https://www.helen.fi/uutiset/2021/meriveden-lammontalteenoton-selvitys-etenee-mukaan-uusia-vaihtoehtoja-ja-uusi-yhteistyokumppani

Challenge: wind turbines and off-shore engineering

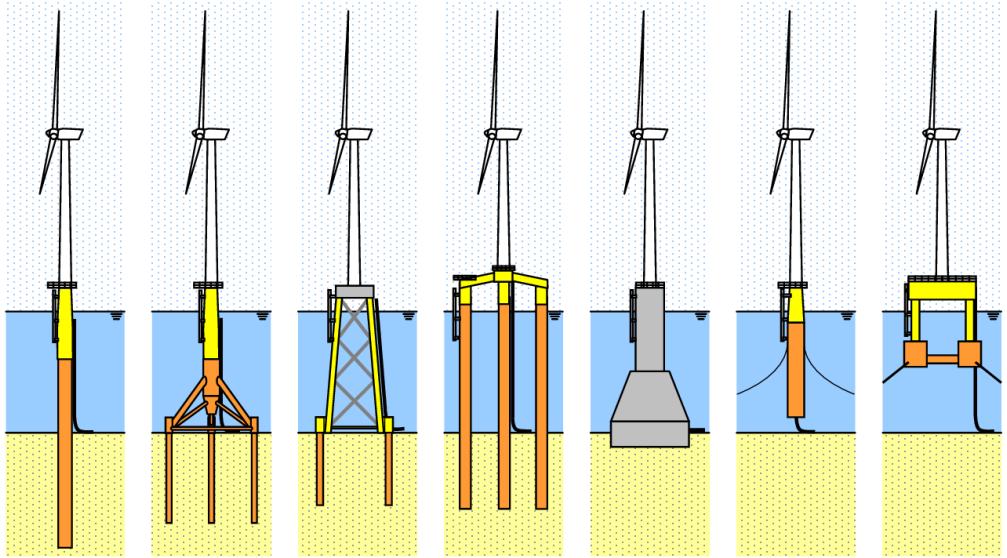
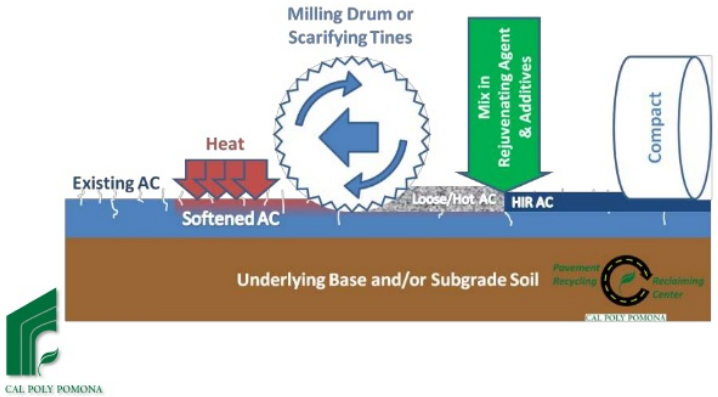


Figure 8: Existing support structure concepts

Challenge: sustainability, recycling and reuse of materials. Maintenance of roads

Hot In-Place Recycling (HIR): Remixing



Lapland firm wins US award for road maintenance tech

The award recognised a joint project involving the Rovaniemi firm Roadscanners and the Finnish Transport Agency.

Challenge: High speed railway

Finland to establish new companies to manage major rail projects

FINLAND's Ministerial Economic Affairs Committee has given the Ministry of Transport and Communications approval to establish new companies to manage the implementation of two major rail projects.

© David Gubler

Geoengineering

- We teach rock engineering, geotechnics and highway engineering
- We are a small programme: we take around 35 students each year
- Around half of the students is joining us from outside Aalto

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Aalto University

Programme structure

- Two years of study
- Three study paths

  (you can choose more than one)
- 120 credits
- Typical student:

  - Summer job
  - Part time work in 2nd year
  - Industry sponsored MSc thesis (with fully paid salary)
  - Full time job immediately after finishing the studies

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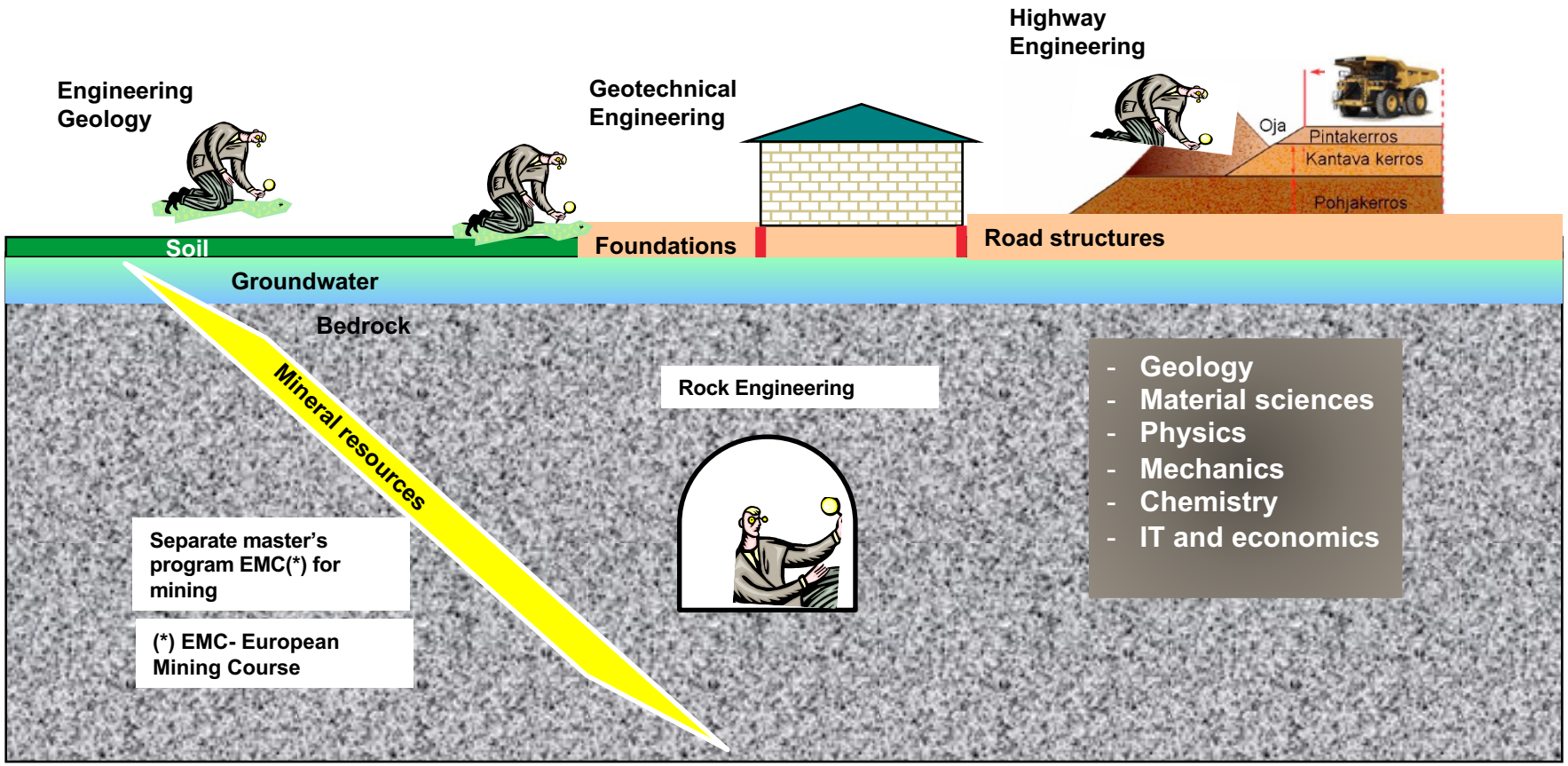
Geoengineering at Aalto 2022 - study paths



Master’s Programme in Geoengineering

Common studies (30 cr)

Obligatory courses (5 cr each)

- Engineering Geology
- Geotechnics
- Structural Design of Roads
- Rock Excavation
- Building Materials Technology (CIV)
- Finite Element Method

Elective studies (30 cr)

- Include also “Advanced studies” (recommendation)
- Exchange studies warmly recommended!

Master’s thesis (30 cr)

- See instructions in Aalto Into

https://into.aalto.fi/display/engeo/Completing+your+master%27s+thesis

Curriculum 2022-2024 - Master's Programme in Geoengineering - Into (aalto.fi)

Advanced studies (30 cr)

Student selects 6 courses (5 cr each)

- Advanced Soil Mechanics
- Bituminous Materials and Mixtures
- Economic Geology and Mineral Economics
- Foundation Eng. and Ground Improvement
- Fundamentals of Structural Design (CIV)
- Geometric Design of Roads
- Numerical Methods in Geotechnics
- Project Course in Geoengineering
- Reinforced Concrete Structures (CIV)
- Road Maintenance and Rehabilitation
- Rock Construction
- Rock Mechanics
- Seminar in Geoengineering
- Special Assignment in Geoengineering
- Design Process Management (CIV)

Minor in Geoengineering and mineral based materials

Examples of course packages (min 25 ECTS)

Geomaterials	Geotechnical	Highway Engineering	Rock Engineering, Mining and Mineral Resource Engineering
CIV-E1010 Building Materials Technology			
CIV-E2030 Experimental Methods in Building Materials	GEO-E2010 Advanced Soil Mechanics	GEO-E1030 Structural Design of Roads	GEO-E2030 Rock Mechanics
GEO-E3010 Economic Geology and Mineral Economics	GEO-E2080 Foundation Engineering and Ground Improvement	GEO-E3040 Geometric Design of Roads	GEO-E3010 Economic Geology and Mineral Economics
GEO-E2050 Bituminous Materials and Mixtures	GEO-E1050 Finite Element Method	GEO-E3030 Road Maintenance and Rehabilitation	GEO-E2040 Rock Construction
GEO-E2090 Project course in Geoengineering			

https://into.aalto.fi/pages/viewpage.action?pageId=53681500

European Mining Course (EMMEP-EMC)

- International Master's Programme in Mining
- Studies at Aalto, Aachen RWTH and Delft TU and Montän Universität Leoben (start 2023)
- Sought after professionals in resource engineering and in construction

https://www.emmep.org/2022%20EMC

Geology, Rock mechanics, Mineral processing

Reserve Modelling and Estimation, Feasibility Studies of mining projects

Mining, Ventilation, Deposit modelling

Interested to join?
Contact mikael.rinne@aalto.fi

Minor in Mining and Minerals Engineering

Select 5 courses, total of 25 cr.

ENG-Courses

- GEO-E1040 Rock Excavation, (III).*.
- GEO-E1010 Engineering Geology, (IV).*
- GEO-E3010 Economic Geology & Mineral Economics, (II).
- GEO-E2030 Rock Mechanics, (I).
- GEO-E3020 Field Experience and Project in Hard Rock Mining, (II).
  Pre-requisite GEO-E2030, CHEM-E6140.

CHEM-courses

- CHEM-E6140 Fundamentals of Minerals Engineering and Recycling, (I). **
- CHEM-E6130 Metal Recycling Technologies, (II). **
- CHEM-E6145 Unit Operations in Mineral Processing and Recycling, (III-IV) (pre-requisite CHEM-E6140)
- CHEM-E6235 Circular Economy for Materials Processing, (IV-V).
- CHEM-E6215 Circular Economy Design Forum, (IV).

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(*) Student studying the MSc programme Geoengineering cannot include this course in the Minor (already a mandatory course).
(**) Student with the major in Sustainable Metals Processing can not include this course in the Minor.
Each course 5 cr.

Exchange and internship possibilities

Summer jobs and part-time employment in 2nd year of studies is quite typical

Wide range of universities for exchange studies (recommended 2nd year), including Nordics, Europe, South Korea, China

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Career opportunities

Close links to industry:

- lack of monotony!
- new technologies!
- Large investments in infrastructure
- Three times more designers retire than is coming to the market


© green recruitment company

Student life

- **Very closely knit community, between students, teachers and industry**
- **Social network for life, especially if you stay in Finland**
- **Aalto students life is among best in the country**
  - **Work hard, play hard**
- **Studies can be challenging, when you decide to work during the studies. However, thanks to great community, the students tend to cope well**

Student club:
https://mkr.ayy.fi/?lang=en
Geotechnical and rock engineering club
Maa- ja kalliorakentajat ry

Study Geoengineering and lead the change for the sustainable future in construction!

Professor Wojciech Sołowski
Geotechnical Engineering
Programme director

Professor Mikael Rinne,
Rock Mechanics

Professor Leena Korkiala-Tanttu,
Geotechnical Engineering

Prof. Augusto Cannone Falchetto
Highway Engineering

Professor Jussi Leveinen,
Engineering Geology

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See you soon!

aalto.fi

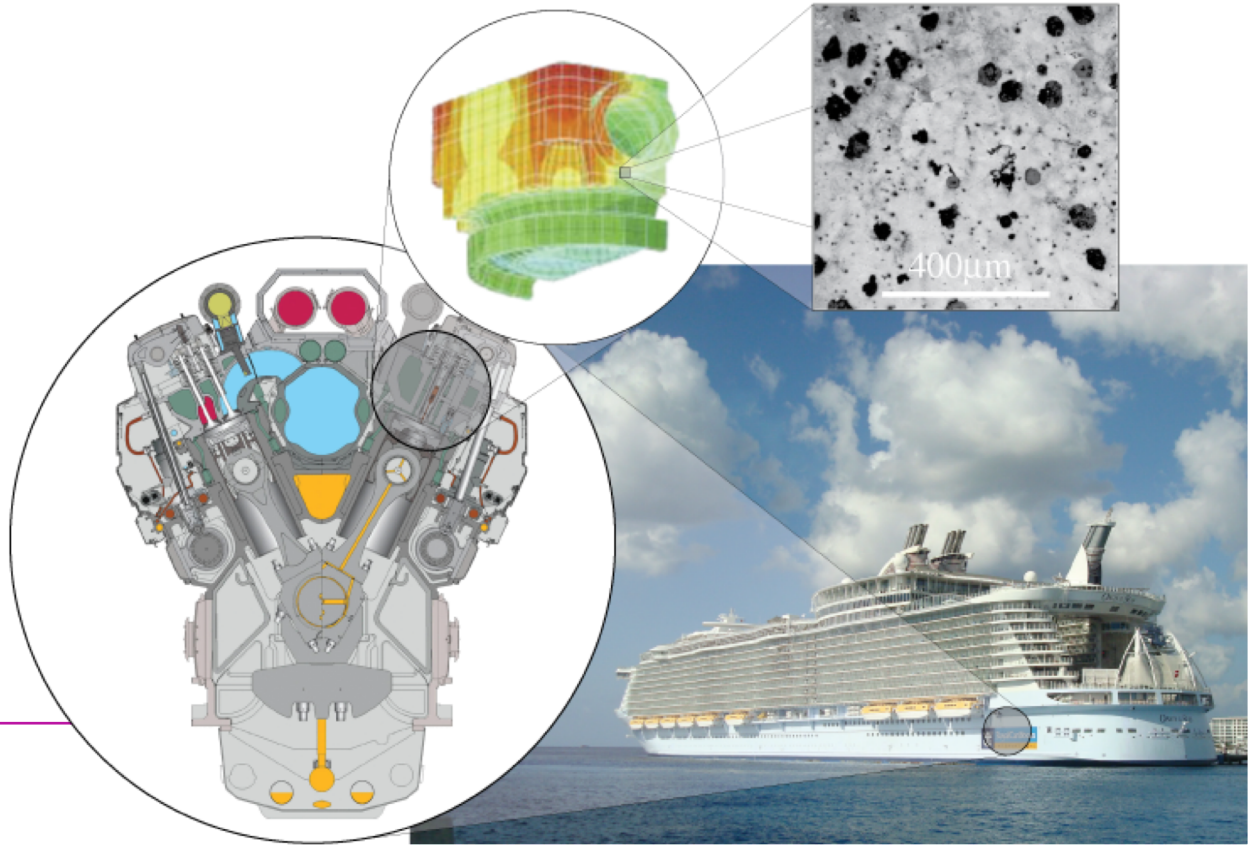
Aalto University
School of Engineering

M.Sc. Programme in Mechanical Engineering

Jukka Tuhkuri

Mechanical Engineering

mechanics across multiple length scales



Aalto University
School of Engineering

Mechanical Engineering at Aalto

RESEARCH

Product Development

Mechatronics

Production Engineering

Engineering Materials

Solid Mechanics

Marine Technology

Arctic Technology

INFRASTRUCTURE

Design Factory

Experimental co-creation platform

ADDLAB

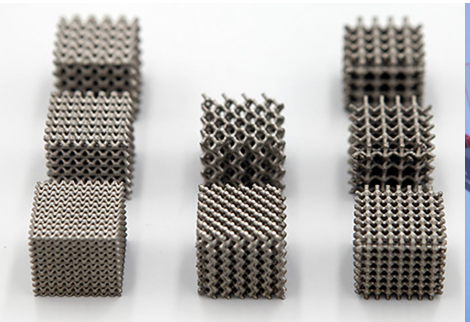
Digital design and manufacturing, eg. 3D printing

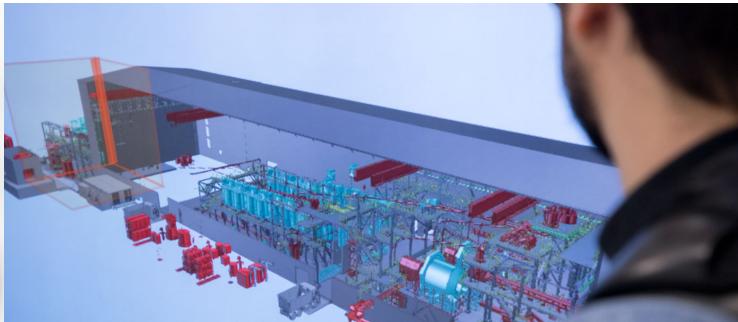
Aalto Ice and Wave Tank

40m x 40m basin

Industrial Internet Campus

Experimentation of Industrial Internet, IoT, AI





Examples of engineering professions

Systems engineer

Understanding and designing complex systems of different scales, from atomic to global

Entrepreneurial engineer

Creating innovative and competitive products, processes and services

Engineering scientist

Conducting basic research to address compelling global challenges such as energy and sustainability

Engineering manager

Leading projects and businesses

Mechanical Engineering Programme

To excel as an engineer,

- You need both creativity and a rigorously analytical mindset,
- You understand the principles and methods of mechanics in engineering,
- You know how to solve engineering problems in your area of specialization,
- You can justify your choices and methods, communicate clearly, and collaborate effectively,
- You appreciate the economic, environmental, and societal context in which your work is important.

Mechanical Engineering Programme

Common studies (31 cr.)
Advanced studies (30cr.)
Electives (29cr.)
M.Sc. Thesis (30 cr.)

In MEC, every student selects a specialization and builds up their own professional identity. There is a lot of options to choose.

The Department of Mechanical Engineering recommends a number of Study Paths within seven Topic Groups, see into.aalto.fi

But you are free to select you own course combination also.

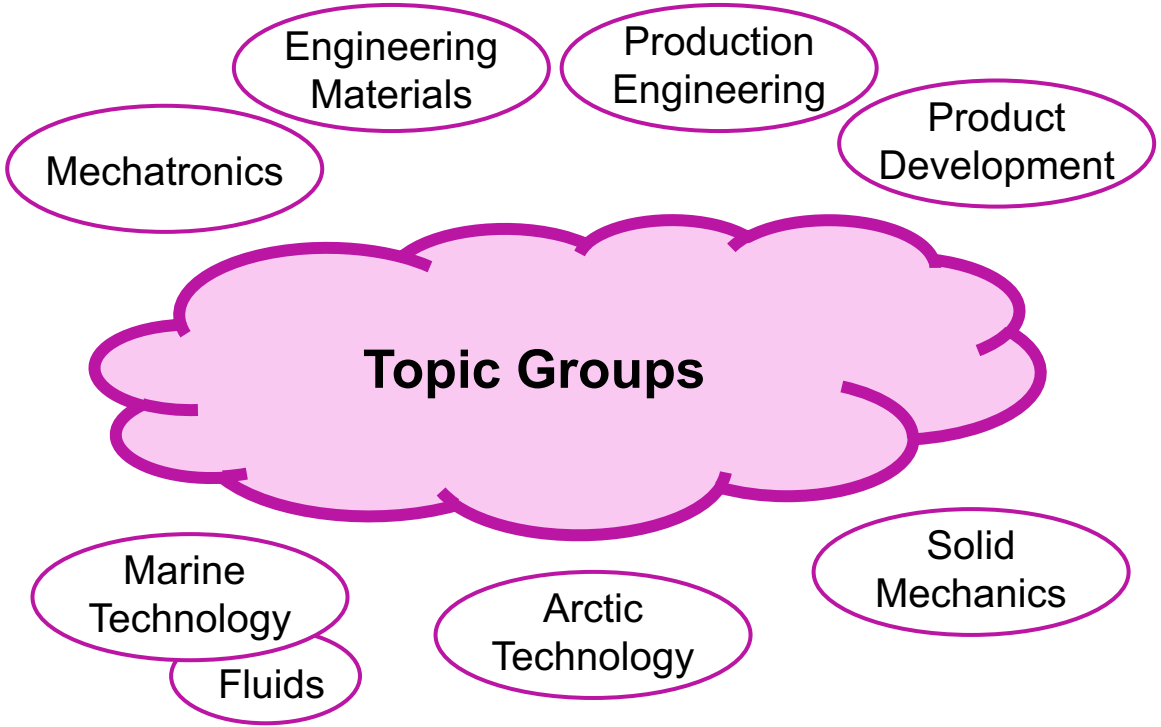
Mechanical Engineering Programme

Common studies
(31 cr.)

Advanced studies
(30cr.)

Electives
(29cr.)

M.Sc. Thesis
(30 cr.)



Common Studies – 31 cr

1. Mechanical Engineering in Society (5 cr) and an integrated course on Communications Skills (1 cr) are compulsory.
2. Select 25 cr from the list of common courses, see Into.
3. Should be completed during the first year.
4. The common courses can be included in advanced studies also.
5. It is recommended that the common studies include a project course: *Machine Design Project*, *Principles of Naval Architecture*, or *Modelling in Applied Mechanics*. If not, then a project course must be included in advanced studies or elective studies.

Advanced Studies – 30 cr

1. Select 30 credits from the courses listed at Into.
2. The Department recommends a number of **Study Paths** within seven **Topic Groups**, see into.aalto.fi, but you are free to select you own course combination also.
3. Course-specific prerequisites must be are satisfied.
4. Common studies courses can be included in advanced studies.

Elective Studies – 29 cr

1. You can choose courses at Aalto, at other universities in Finland, or at our partner universities abroad.
2. You can take additional mechanical engineering courses. Consult the Study Paths for suggestions.
3. You can complete a minor. For a list of minors at Aalto, see Into.
4. Foreign language studies (min 3 cr) are a compulsory, if they have not been part of the BSc degree. For international students, Finnish and Swedish language courses are highly recommended.
5. You can include 1-5 credits of practical training.

Thesis – 30 cr

1. The master's thesis is written on a topic related to the Advanced Studies, as agreed with a supervising professor.
2. Professors provide thesis topics that are related to their research activities. You can also suggest your own topic, if you find one at the industry, at a research institute, or elsewhere.
3. The recommended time of the thesis project is the second year spring.