Aalto University
School of Engineering

Overview of Rock Engineering and Mining education at Aalto University

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Overview of rock engineering and mining education at Aalto University over the past 20 years

- Rock Engineering (Kalliotekniikka)
- European Mining Course (EMC)
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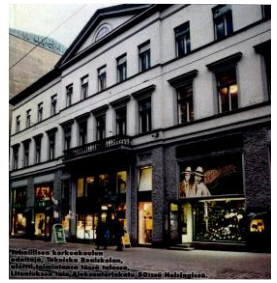
Overview Rock Engineering and Mining in Aalto

- 1872 Mineralogy at Teknillinen reaalikoulu, later named Polyteknillinen opisto
- 1937 Chair in mining at Helsinki Univ. of Technology at Bulevardi, (TKK)
- 1947 Establishment of the faculty of mining (Vuoriteollisuusosasto)
- 1964 TKK move from Helsinki city to Espoo (mining faculty to Vuorimiehentie)
- 1987 Establishment dept. of ”Materials and Rock Engineering” (Materiaali- ja kalliotekniikan laitos)
- 1996 Establishment European Mining Course (EMC) as an exchange program
- 2005 Two-part degree structure (Bachelor's and Master's programs).
- 2005 Rock Engineering /EMC from degree programme “Materials and Rock Engineering” to “Civil and Environmental Engineering”
- 2010 Start of Aalto University (submerge of universities of technology, business and arts)
- 2013 Renewal of BSc programs (start of ENY/KJR programs)
- 2014 Physical move from Vuorimiehentie to Rakentajanaukio
- 2014 EMC Full Master’s program, partners Aachen and Delft
- 2016 Renewal of Master’s programs (incl. Geoengineering)
- 2022 Renewal BSc program (ENY/KJR => Rakennustekniikka, RAK)
- 2022-2023 Renewal of EMC, coordinated by Aalto, partners Aachen and Leoben.



Aalto University -A merger of leading Finnish universities in 2010

University of Art and Design Helsinki (TaiK)
Helsinki School of Economics (HSE)
Helsinki University of Technology (TKK)

A community of:

- 100,000 alumni
- 12,000 students
- 4,200 faculty & staff witch of 400 professors

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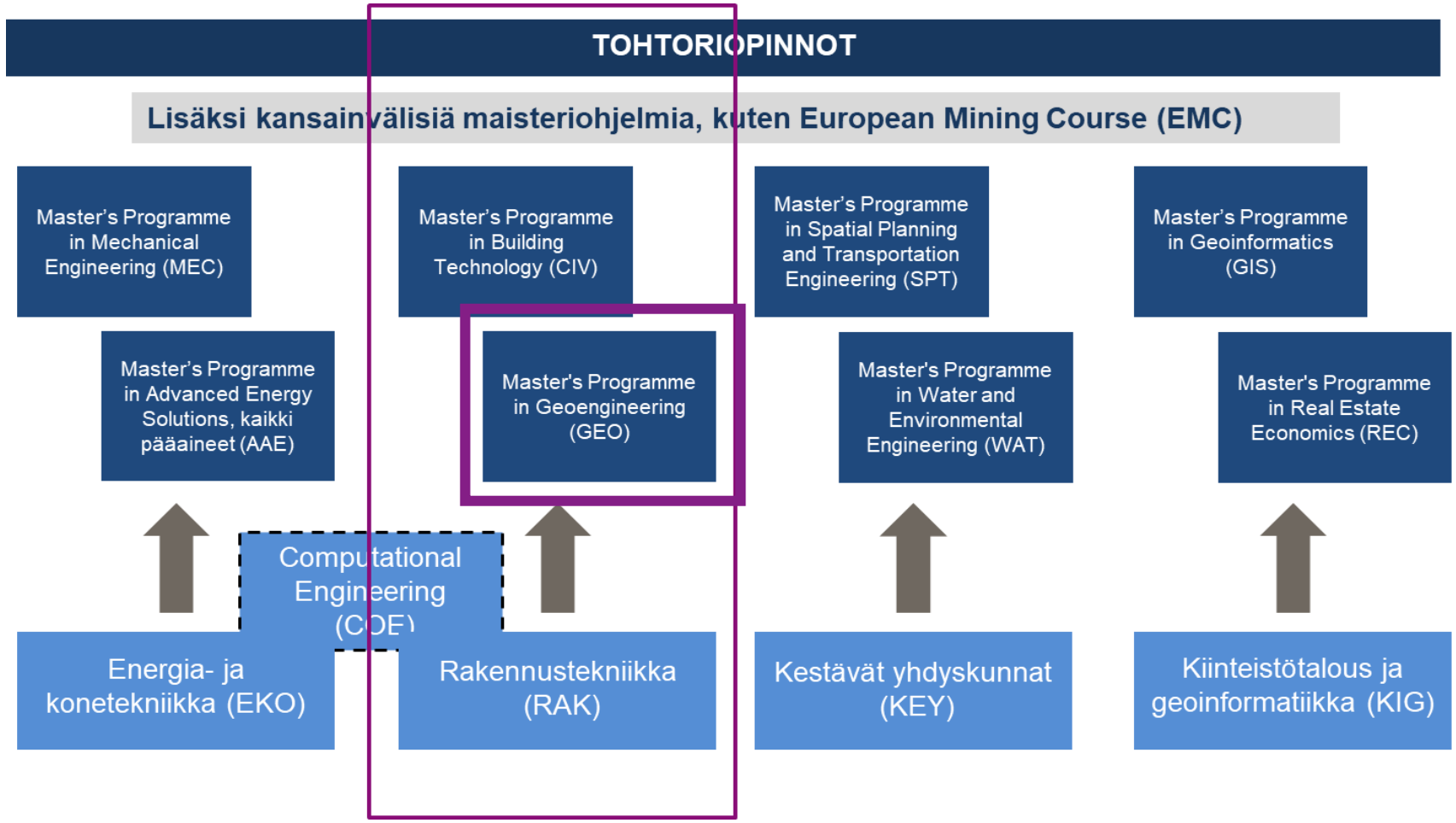
- **Rock Engineering and Mining is organized by the department of Civil Engineering.**
- **Civil Engineering is one of the three departments of the School of Engineering.**

Aalto, School of Engineering, main study programmes

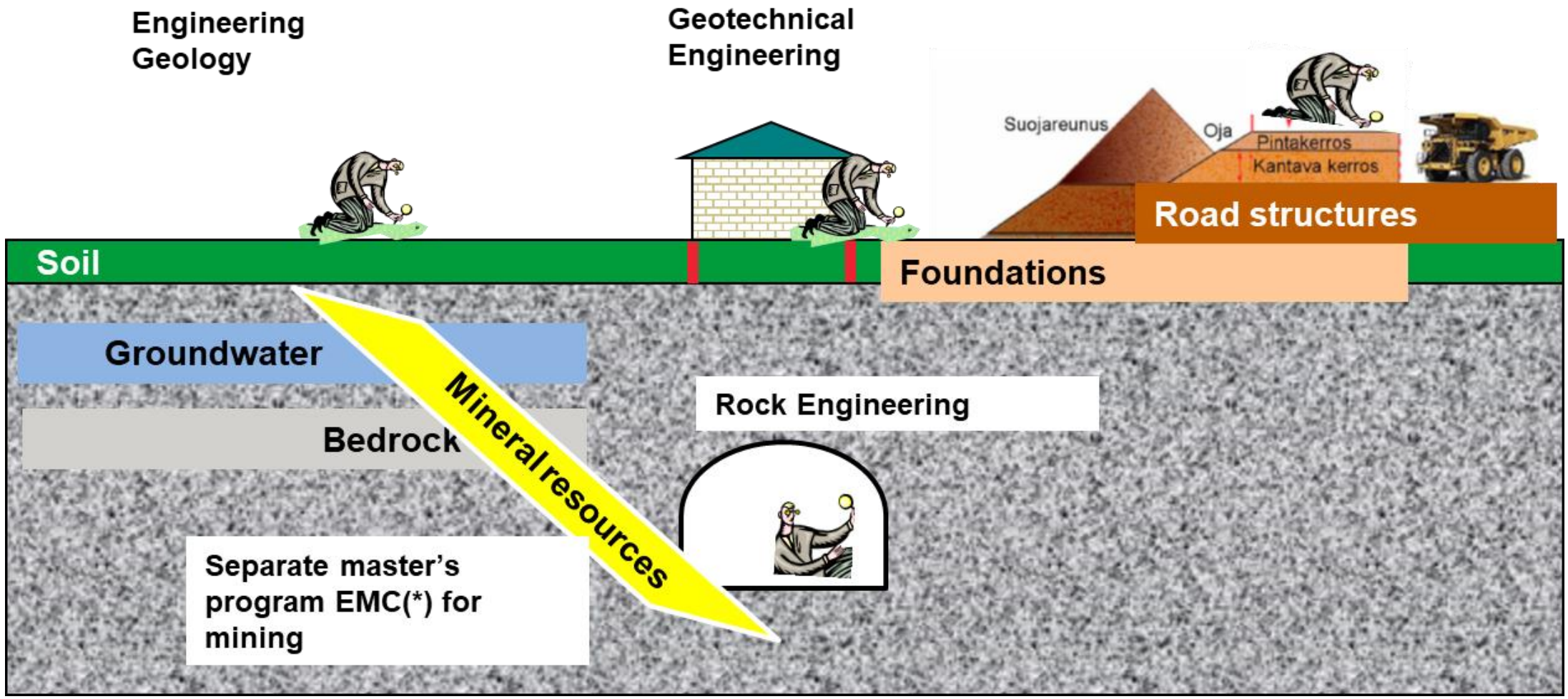
2016 Renewal of MSc programmes

2022 Renewal of BSc programmes



Geoengineering at Aalto – study paths

- Intake about 20 students /year



(*) EMC- European Mining Course.

Geoengineering at Aalto since 2016 – curriculum 2024-2025

Common courses (20 cr)

Obligatory courses (5 cr each)

- Engineering Geology
- Geotechnics
- Structural Design of Roads
- **Rock Excavation**

Elective studies (30 cr)

- Include also “Advanced courses”
- Minors, e.g. “Mineral Resource Engineering”
- Exchange studies warmly recommended!

Master’s thesis (30 cr)

Advanced courses (40 cr)

Student selects 8 courses (5 cr each)

- Advanced Soil Mechanics
- Bituminous Materials and Mixtures
- Design Process Management (CIV)
- 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**
- Special Assignment in Geoengineering

Rock Engineering influenced courses at TKK => Aalto

2010 TKK/Aalto		2025 Aalto	
Bachelor courses			
1) Rock Excavation	(5 cr)	1) Geoengineering and Georesources	(5 cr)
2) Rock Mechanics	(3 cr)	2) Geology and Geotechnics	(5 cr)
3) Blasting Engineering	(2 cr)		
4) Geotechnics basics	(5 cr)		
5) Geotech. for infra/structures	(5 cr)		
Master's courses			
1) Rock Construction	(5 cr)	1) Rock Excavation	(5 cr)
2) Design of UG excavations	(10 op)	2) Rock Construction	(5 cr)
3) Mining Engineering	(5 cr)	3) Rock Mechanics	(5 cr)
4) Ore Geology	(3 cr)	4) Engineering Geology	(5 cr)
5) Mining Geology	(3 cr)	5) Economic Geology & Mineral Econ.	(5 cr)
		6) Numerical Methods in Geotechnics	(5 cr)
		7) Project Course in Geoengineering	(5 cr)

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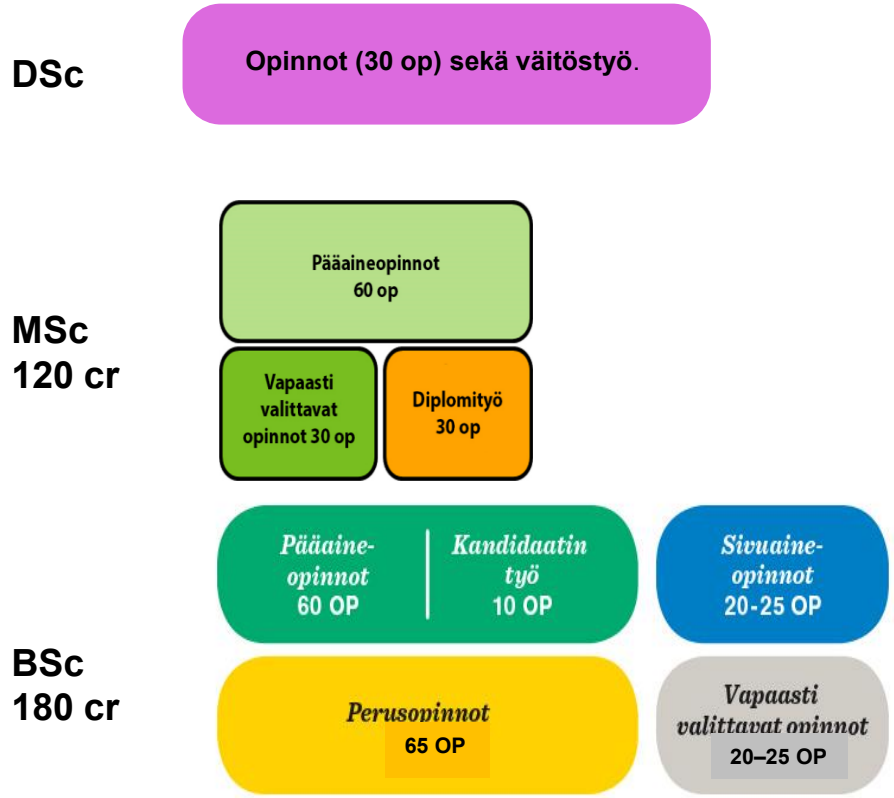
Rock Engineering curriculum changes since 2010

- Since 2016 all MSc programmes and teaching in English
  => significant increase of international students and professors => diverse student's background
- Digitalization of teaching continues (digital material, on-line teaching, automated exam assessment, VR etc)
- Cost-savings and operational efficiency
- Decreased use of external teaching
- Less rock engineering and mining. Instead:

  + more numerical modelling,
  + more structural eng. & concrete technology
  + highway engineering included
  + more elective studies,
  => more diverse specialization options

Curriculum still meets requirements for **FISE** qualifications in Rock Construction.



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European Mining Course

EMC
Resourcing a sustainable future

- Initiated in 1996 by Delft University, Aachen RWTH, Imperial College of London and Helsinki University of technology
- Organized mobility between three universities
- Since 2014 Triple Degree Master's Programme
- Since 2022 Coordinated by Aalto, Leoben joined
- Strong industrial support by FEMP
- Intake about 20 students/year

Finland

Germany

MRE Institute of Mineral Resources Engineering | RWTH AACHEN UNIVERSITY

Austria

Technical University of Leoben

FEMP
FEDERATION OF EUROPEAN MINERAL PROGRAMS

EMC curriculum 2025

1st semester at Aalto University

Course	ECTS
Fundamentals of Minerals Engineering and Recycling	5
Rock Mechanics	5
Economic Geology and Mineral Economics	5
Field Experience and Project in Hard Rock Mining	2
Integrated Project Communication for MSc Students (o, w) *	3
Engineering Principles for Metallurgical Processes	5
Fundamentals of Pyrometallurgy	5
	30

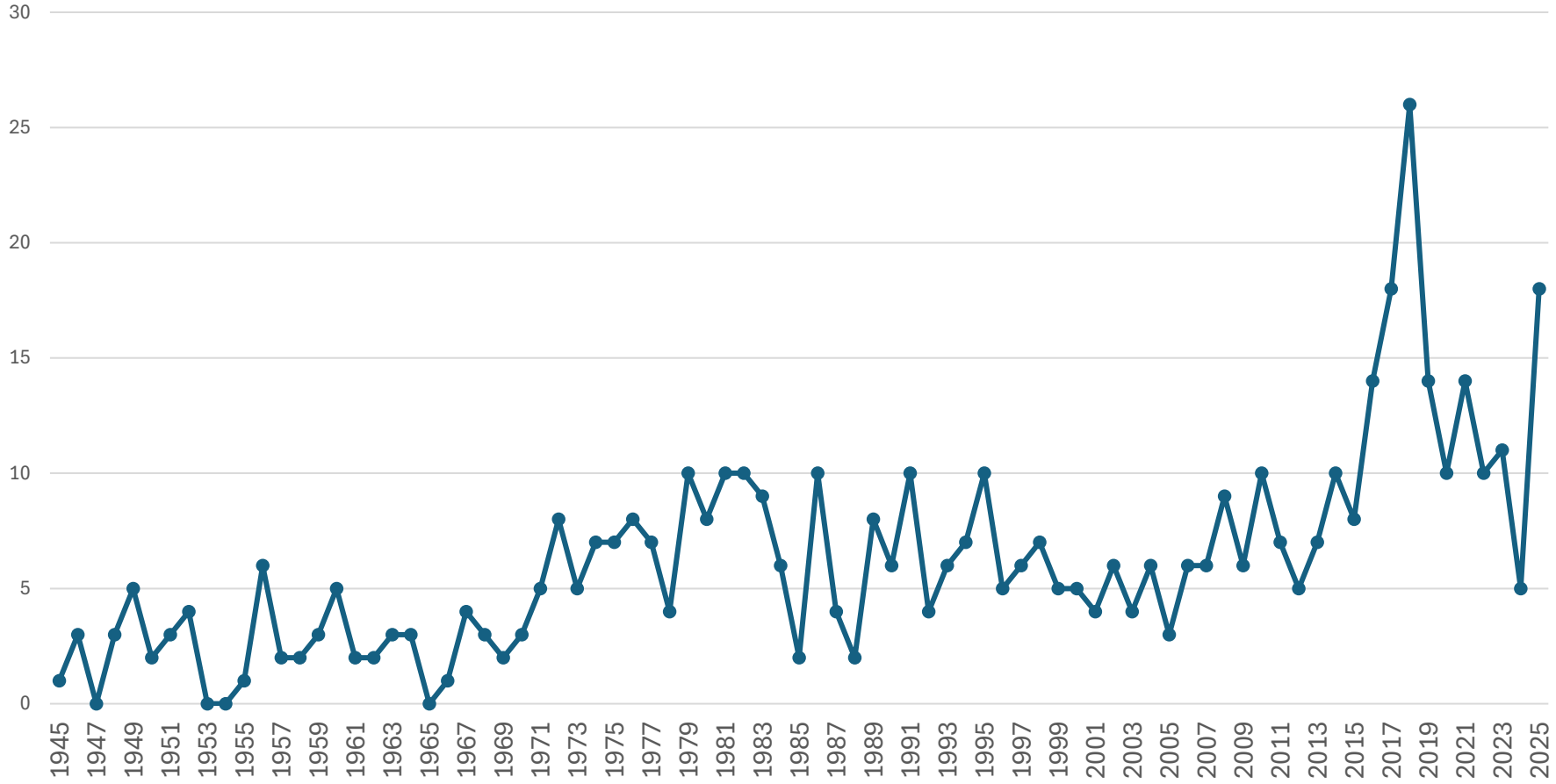
2nd semester at RWTH Achen

Course	ECTS
Mine Waste	5
Feasibility Studies of Mining Projects	5
Mine Design and Simulation	5
Mine Ventilation	5
Reserve Modelling and Estimation	5
Case Study: Mining Project	5
	30

3dr semester at University of Leoben

Course	ECTS
Continuous Mining Methods and Conveying Technologies in Surface and Undergound Mining	3
Open Pit Mining	4
Mineral Economics	3
Occupational and Process Safety	3
Sustainable development: History of thought, basic concepts and current applications	6
Underground Mining	4
Optional courses (select 7 ETCS)	
Artisanal and Small-scale Mining in Development Countries	3
Excavation Engineering	3
Marine Mining	2
Mining in Austria, the European Union and Worldwide	1
Seminar in Mining Engineering and Mineral Economics	2
	30

Graduates: Rock Engineering and Mining 1945-2025



Ongoing MSc thesis
by 7.10.2025

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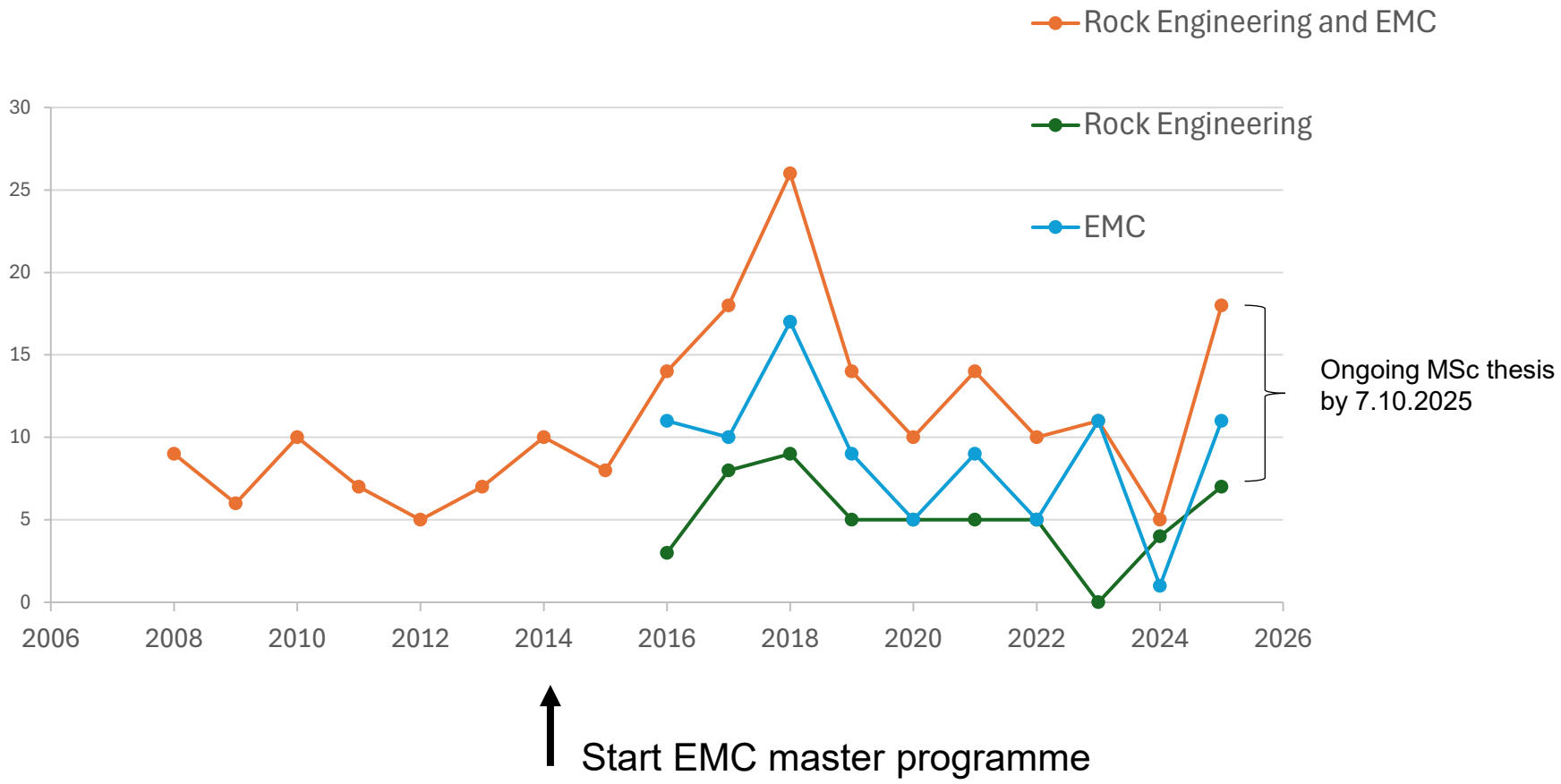
Graduates: Rock Engineering and EMC 2008-2025

- All ≈ 14/year
- Rock Engineering ≈ 5/year
- EMC ≈ 9 /year



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Doctoral education

- Article-based theses are strongly recommended
- Doctoral thesis 2015-2025:
  - Mining, Nuclear waste disposal and Heat storages
  - Rock mechanics related to above
  - Safety and environment.

- Common to get funding for master's thesis, but challenging to get funding for doctoral studies
- Indications for increased research governmental funding (Business Finland, Research Council). However, industry co-operation and co-funding is required.

Doctoral thesis 2015-2025	Year
A new method to improve operating performance for underground hard rock mining	2015
Excavation damage zones, fracture mechanics simulation and in situ strength of migmatitic gneiss and pegmatitic granite at the nuclear waste disposal site in Olkiluoto, Western Finland	2015
Prediction of stress-driven rock mass damage in spent nuclear fuel repositories in hard crystalline rock and in deep underground mines	2018
Geotechnical classification and Bayesian network for real time risk assessment in mining	2019
Technical and economic aspects of storage and extraction of heat in crystalline bedrock	2019
Emission of particulate matter (PM) in open-pit quarrying in Finland	2023
Photogrammetry for characterizing rock fracture roughness, physical aperture, and hydromechanical properties	2024
Physical properties of rocks in Olkiluoto - implications for the deep geological disposal of spent nuclear fuel	ongoing
Blasting induced vibrations – formation, progression and distribution regarding drill and blast -method in hard rock	ongoing

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Resources

2005 Staff

- professor
- lecturer- permanent
- assistant (doc student)
- doctoral students, mainly project funded
- laboratory manager
- technician
- secretary

- Managed by Laboratory of Rock Engineering (Kalliotekniikan laboratorio)

2025 Staff

- professor
- lecturer- fixed term
- staff scientist
- doctoral students, mainly project funded
- laboratory manager – technical organisation
- technician – techn.org.
- secretary services and HR – separate organisation

- Managed by the Department of Civil Engineering
- Part of research Team “Mineral Based Materials and Mechanics”

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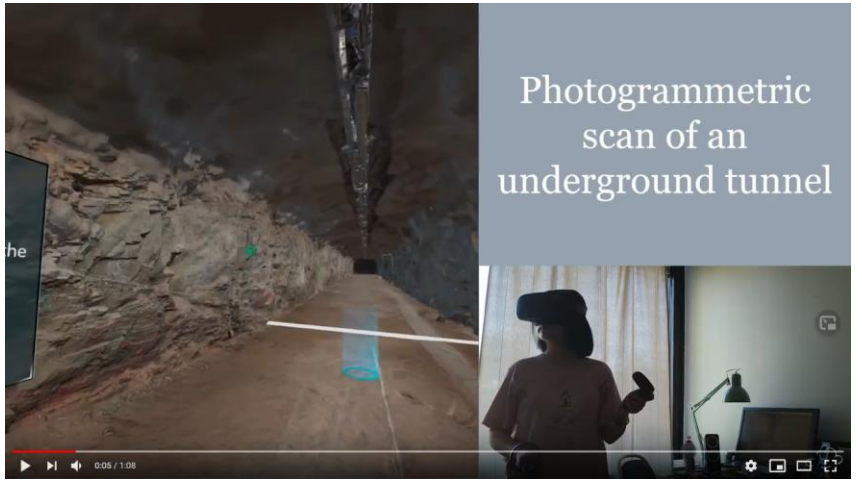
Observations

- Strong competition especially of domestic students, which puts small programs at risk of disappearing /submerging with other programs
- Without international students, the Geoengineering program might have already died out
- Finnish speaking students have good employment prospects, foreign students without language skill have problems
- Governmental block funding for university will decrease?
- Despite the challenging funding environment for education, the future views for rock/ mining engineers are strong.
- This should be communicated to elementary students, highlighting the positive environmental opportunities in these fields.



Thanks!