

LMS | ACTIVITY REPORT 2021

Courses taught

BA, MA and Doctoral level at EPFL

The column "Credits / Coeff." indicates Coefficient for first-year students (BA1-2), Credits for the others

Spring semester 2021

Teacher(s)	Code	Course title	Section-Semester	Credits / Coeff.	Student number
Laloui, Lyesse (LMS); Fernandez Andriano, Juan (SAR-ENS); Nguyen, Richard (SAR-ENS); Molinas, Margaux (EML)	PENS-211	Terra Epidermis	ENAC-BA4	4	19
Vulliet, Laurent (LMS)	CIVIL-203	Mécanique des sols et écoulements souterrains	GC-BA4	5	57
Laloui, Lyesse (LMS)	CIVIL-444	Energy geostructures	GC-MA2, GC-MA4	4	11
Nussbaum, Christophe (SGC-ENS)	CIVIL-428	Engineering geology for geo-energy	GC-MA2, GC-MA4	3	11
Ferrari, Alessio (LMS)	CIVIL-530	Slope stability	GC-MA2, GC-MA4	3	22

Fall semester 2021

Teacher(s)	Code	Course title	Section-Semester	Credits / Coeff.	Student number
Vulliet, Laurent (LMS); Defert, Raphaël (SGC-ENS)	CIVIL-438	Analyse et gestion de risques	GC-MA1, GC-MA3	3	38
Laloui, Lyesse (LMS); Koliji, Azad (SGC-ENS)	CIVIL-402	Geomechanics	GC-MA1, GC-MA3	3	44
Laloui, Lyesse (LMS); Terzis, Dimitrios (LMS)	CIVIL-424	Innovation for construction and the environment	GC-MA1, GC-MA3	3	40

Additional teaching

Teacher(s)	Course title	Section-Semester	Credits	Student number	Institution where taught (if not EPFL)	Additional information on external institution(s)
Ferrari, Alessio (LMS)	A Resilient Future: Science and Technology for Disaster Risk Reduction	EPFLx - edX Course				Silvia Hostettler, Cooperation & Development Center, EPFL

Advising

Postdoc works (completed in 2021 or ongoing)

Advisee	Research topic	Starting (month/year)	End, if known (month/year)	Supervisor(s)	Institution(s) involved (if not EPFL)	Additional information on external institution(s) involved
Bosch Llufríu, Jose Antonio (LMS)	Bio-chemo-hydro-mechanical modelling of microbially induced cementation in soils.	06/2021		Laloui, Lyesse (LMS)		
Clarà Saracho, Alexandra	Biomimetic control of calcium carbonate phase through capsule-based MICP and its application for soil improvement	01/2020	05/2021	Laloui, Lyesse (LMS)		
Crisci, Eleonora (LMS)	Time-dependent response and sample-size effect on the geomechanical response of Opalinus Clay shale for radioactive waste disposal	11/2019	08/2021	Laloui, Lyesse (LMS)		
Houhou, Roba (LMS)	Desiccation Cracking of biocemented clays.	05/2021		Laloui, Lyesse (LMS)		
Madaschi, Aldo (LMS)	Modelling activities on buffer and host rock materials for High Level Waste geologic repositories	10/2016	06/2021	Laloui, Lyesse (LMS)		
Ravera, Elena (LMS)	Energy geostructures.	12/2021		Laloui, Lyesse (LMS)		
Stavropoulou, Eleni (LMS)	Impact of CO ₂ on the sealing capacity of caprock representative shale	09/2019		Laloui, Lyesse (LMS)		
Terzis, Dimitrios (LMS)	Bio-cementation.	09/2019		Laloui, Lyesse (LMS)		
Tuttolomondo, Angelica (LMS)	Scale effects in Opalinus Clay. New insights in the analysis and prediction of the mechanical behavior of compacted expansive clays as engineered barriers. In-situ stress estimation methodologies. Cavitation in undrained processes.	03/2021		Laloui, Lyesse (LMS)		

PhD thesis (completed in 2021 or ongoing)

Advisee	Thesis title	Doctoral Program	Completion year	Advisor(s)	Co-advisor(s)	Other(s)	Institution(s) involved (if not EPFL)	Additional information on external institution(s) involved
Bosch Llufriu, Jose Antonio (LMS)	Studies on the mechanical evolution of compacted bentonite subjected to environmental actions	EDME	2021	Laloui, Lyesse (LMS)	Ferrari, Alessio (LMS)			
Elmaloglou, Ariadni (LMS)	Process Efficiency Optimization of Bio-cementation via Multi-Scale Experiments	EDME	2022	Laloui, Lyesse (LMS)	Terzis, Dimitrios (LMS)			
Fuselier, H��lo��se (LMS)	Thermo-hydro-mechanical behaviour of the Callovo-Oxfordian claystone under thermal changes	EDME	2024	Laloui, Lyesse (LMS)	Ferrari, Alessio (LMS)			
Garbellini, Cristiano	Advances in the Soil-Structure Interaction Analysis from Surface Footings to Thermoactive Deep Foundations.	EDME	2021	Laloui, Lyesse (LMS)				
Harran, Ray (LMS)	Mechanical performance and upscaling of bio-improved soils	EDME	2022	Laloui, Lyesse (LMS)	Terzis, Dimitrios (LMS)			
Kim, Jinwoo (LMS)	An effective stress framework for partially saturated gas shales	EDME	2022	Laloui, Lyesse (LMS)	Ferrari, Alessio (LMS)			
Kim, Taeheon (LMS)	Geomechanical response of geomaterials to chemical reactions with CO2	EDME	2022	Laloui, Lyesse (LMS); Ferrari, Alessio (LMS)				
Llabjani, Qazim (LMS)	Gas-Induced Impacts on the Barrier Integrity of Deep Geological Repository of Radioactive Wastes	EDME	2024	Laloui, Lyesse (LMS)	Ferrari, Alessio (LMS)			

Advisee	Thesis title	Doctoral Program	Completion year	Advisor(s)	Co-advisor(s)	Other(s)	Institution(s) involved (if not EPFL)	Additional information on external institution(s) involved
Ravera, Elena (LMS)	Cyclic thermomechanical behaviour of pile-soil interface and design methods for energy pile foundations	EDME	2021	Laloui, Lyesse (LMS)				
Tuttolomondo, Angelica (LMS)	Effective stress for unsaturated active clays and in-situ effective stress estimation methodology	EDME	2021	Laloui, Lyesse (LMS)	Ferrari, Alessio (LMS)			
Wang, You (LMS)	Numerical and experimental study on cyclic behavior of MICP-treated soils.	EDME		Laloui, Lyesse (LMS)				
Wojnarowicz, Matthias (LMS)	Performance assessment of FEM models to simulate THM effects in the rock around the FE-tunnel	EDME	2023	Laloui, Lyesse (LMS)	Madaschi, Aldo (LMS)			

Master diploma projects in Civil Engineering, Environmental Engineering and other programs (started in spring or fall 2021)

Advisee(s)	Project title	Section-Semester	Advisor(s)	Co-advisor(s)	Institution(s) involved (if not EPFL)	Additional information on external institution(s) involved
Bonny, Loïc (GC-PME)	Tunnel souterrain, métro m3 de Lausanne	GC-PME	Laloui, Lyesse (LMS)			
Metral, Mathilde (GC-PME)	Runout of landslides in quick clay zones	GC-PME	Ferrari, Alessio (LMS)			
Wiedmer, Alexandre Claude (GC-PMH)	Etude et utilisation de logiciels 4D dans les processus d'entreprise	GC-PMH	Vulliet, Laurent (LMS)			
Yazbeck, Charbel (GC-PMH)	Numerical Modeling of Geomechanical Problems	GC-PMH	Laloui, Lyesse (LMS)			

Master diploma projects in Architecture (completed in spring 2021, retrieved from Infoscience)

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Prestudies of master projects in Civil Engineering (completed in fall 2021)

Advisee(s)	Project title	Section-Semester	Tutors(s)	Supervisors(s)	Institution(s) involved (if not EPFL)	Additional information on external institution(s) involved
Beuchat, Zélie Charlotte (GC-MA3)	Projet: BIM (Building Information Modeling) 5D	GC-MA3	Vulliet, Laurent (LMS)			
Schaufelberger, Annik Julia (GC-MA3)	Design of an energy tunnel	GC-MA3	Laloui, Lyesse (LMS)			
Tomcik, Christopher (GC-MA3)	Caractérisation thermique d'un système de captage et valorisation de chaleur fatale en milieu souterrain	GC-MA3	Laloui, Lyesse (LMS)			
Wiedmer, Alexandre Claude (GC-PMH)	BIM (Building Information Modeling) 5D	GC-PMH	Vulliet, Laurent (LMS)			

Theoretical statements of master projects in Architecture (completed in january 2021, retrieved from Infoscience)

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Semester projects (completed in 2021)

Advisee(s)	Project title	Section-Semester	Tutor(s)	Supervisor(s)	Institution(s) involved (if not EPFL)	Additional information on external institution(s) involved
Abdeljalil, Saad (GC-MA3)	Projet de construction: Variante du projet "enceinte de fouille pour infrastructure ferroviaire". Projet n 10772	GC-MA2	Laloui, Lyesse (LMS)			
Canomeras, Elena (GC-PMH)	Projet interdisciplinaire à option: 10827 Laboratory investigation of the durability of plastic reinforced built materials	GC-MA4	Laloui, Lyesse (LMS)			
Dufour, Noémie Elise (GC-MA1)	Projet interdisciplinaire à option: Projet géotechnique	GC-MA1	Vulliet, Laurent (LMS)			
Ghesquière-Diérckx, Thibault Antoine Marie Joseph (GC-PMH)	Projet interdisciplinaire à option: Supply chain of recycled waste towards becoming built materials	GC-MA4	Laloui, Lyesse (LMS)			

Advisee(s)	Project title	Section-Semester	Tutor(s)	Supervisor(s)	Institution(s) involved (if not EPFL)	Additional information on external institution(s) involved
Heiniger, Selina (GC-MA3)	Projet interdisciplinaire à option: On the feasibility, challenges and opportunities of the integration of recycled plastic in built applications	GC-MA4	Laloui, Lyesse (LMS); Terzis, Dimitrios (LMS)			
Heiniger, Selina (GC-MA3); Schaufelberger, Annik Julia (GC-MA3)	Projet ENAC: Pile interaction effects and environmental impacts of refrigerant on the performance of an energy pile foundation	GC-MA4	Laloui, Lyesse (LMS)			
Jeannet, Ivan (GC-PMH)	Projet de systèmes civils: Gestion des risques	GC-MA4	Vulliet, Laurent (LMS)			
Jeannet, Ivan (GC-PMH)	Laboratoire GC: Hardware and digitalization integration for monitoring energy performance of buildings	GC-MA4	Laloui, Lyesse (LMS)			
Kozel, Loïc (GC-MA1)	Projet de construction: Projet Géotechnique	GC-MA1	Vulliet, Laurent (LMS)			
Levkov, Joana-Sophia (GC-MA3)	Projet de construction: Probabilistic analysis of slope stability	GC-MA3	Vulliet, Laurent (LMS)			
Requena, Esteban (GC-MA1)	Projet de construction: Projet géotechnique	GC-MA1	Vulliet, Laurent (LMS)			
Tomcik, Christopher (GC-MA3)	Projet de construction: Enceinte de fouille en terrain meuble	GC-MA4	Laloui, Lyesse (LMS)			

Other supervisions

Advisee	Type of supervision	Work topic	Starting (month/year)	End, if known (month/year)	Supervisor(s)	Institution(s) involved (if not EPFL)	Additional information on external institution(s) involved
Cassina, Lisa	Others	Master valorisation on Energy performance of a high BHEs density at district scale.	03/2021	07/2021	Laloui, Lyesse (LMS)		
Gandolfi, Paolo	Internship	Bio-cementation on granular packings and micro-structural characterization.	07/2021	09/2021	Terzis, Dimitrios (LMS)	Polytechnic University of Turin, IT (European Universities and Research Centers)	

Advisee	Type of supervision	Work topic	Starting (month/year)	End, if known (month/year)	Supervisor(s)	Institution(s) involved (if not EPFL)	Additional information on external institution(s) involved
Girier , Aurore Armide Rose Flore Suzanne	Internship	Characterization and optimization of the thermal and energetic skills of a geothermal heat exchanger.	05/2021	07/2021	Peltier , Margaux Marie Valérie (LMS)	Ecole normale supérieure (ENS) Paris-Saclay, FR (European Universities and Research Centers)	
Gouin , Judith Hélène (GC-MA2)	Internship	Multi-physical numerical analyses in porous media.	04/2021	08/2021	Terzis , Dimitrios (LMS)	Ecole Polytechnique, FR (European Universities and Research Centers)	
Lucherini , Lorenzo (LMS)	Others	Scientific assistant / Microencapsulation for targeted delivery of MICP treatment and optimization of carbonate mineralization.	03/2020	06/2021	Laloui , Lyesse (LMS); Terzis , Dimitrios (LMS)		
Peltier , Margaux Marie Valérie (LMS)	Others	Scientific assistant / Development of geothermal-inspired technologies for existing built environments	01/2019		Laloui , Lyesse (LMS)		
Romanens , Natacha (LMS)	Apprenticeship	Apprentice, laborant en physique	08/2019		Laloui , Lyesse (LMS); Dubey , Patrick (LMS)		
Sannasardo , Fabiana (GC-E)	Internship	Shear strength of granular bentonite at different hydration states.	09/2021	11/2021	Ferrari , Alessio (LMS)	Polytechnic University of Turin, IT (European Universities and Research Centers)	
Thoumyre , Charles	Others	Construction & Environmental Biocementation in REal World Application.	02/2021	01/2022	Laloui , Lyesse (LMS)		
Tiberghien , Loïc Lucien	Others	Energy geostructure.	01/2021	07/2021	Peltier , Margaux Marie Valérie (LMS)		

Research

COVID impacts on your activities

Empty category

Funded research projects

Title	Principal Investigator (PI)	Co-PI(s)	Funding organisation; Program	Granted amount (CHF)	Starting date	Duration (Months)	Status	External institution(s) involved	Which sustainability challenges does the project tackle?
Visualising the impact of CO2 on the microstructure of an argillaceous caprock	Stavropoulou Eleni	Stavropoulou Eleni	FNS; FNS-SPARK	100,000 out of 100,000	01.12.2020	12	Completed		Climate change
Experimental assessment of shale properties for safe geological CO2 storage	LALOU Lyesse	Tinguely Barbara	Non lucr.; Mont Terri	10,000 out of 10,000	01.10.2020	15	Completed		Climate change
INNOBOOSTER MEDUSOIL	Terzis Dimitrios		Non lucr.; GR Stiftung	130,000 out of 130,000	01.06.2019	21	Completed		Climate change Urbanization and territorial development
Cyclic Thermo-Mechanical Behaviour of Energy Piles	LALOU Lyesse		FNS; FNS-Project Funding	450,000 out of 450,000	01.11.2017	49	Completed		Climate change Urbanization and territorial development
Hosting the Greenhouse Gas Technology Conference GHGT-13 at the Swiss Tech Centre of EPFL	LALOU Lyesse		Off. Conf.; Divers Confédération	350,000 out of 350,000	01.11.2013	98	Completed		Climate change

Title	Principal Investigator (PI)	Co-PI(s)	Funding organisation; Program	Granted amount (CHF)	Starting date	Duration (Months)	Status	External institution(s) involved	Which sustainability challenges does the project tackle?
Assessing and exploiting the interaction between ventilation and geothermal systems in energy tunnels	LALOUI Lyesse	Ten Bosch Sofie	Off. Conf.; Innosuisse	62,591 out of 62,591	01.01.2022	12	Granted	Amberg Engineering, CH (Private sector)	Climate change Digitalization of cities and infrastructure Urbanization and territorial development
Study on effective stress definition for gas shales in partially water saturated conditions	Lyesse LALOUI		; Chevron USA Inc.	150,000 out of 150,000	06.12.2017	37	Industrial contract		Climate change
THM-model validation in the context of the FE modelling Task Force	Lyesse LALOUI		; NAGRA National Cooperative for the Disposal of Radioactive Waste	180,000 out of 180,000	01.01.2019	36	Industrial contract		Climate change
Study on effective stress definition for gas shales in partially water saturated conditions - Avenant 1	Lyesse LALOUI		; Chevron USA Inc.	30,000 out of 30,000	06.12.2017	37	Industrial contract		
Geomechanical behavior of Opalinus Clay: time-dependent, scale effects and constitutive model validation	Lyesse LALOUI		; NAGRA National Cooperative for the Disposal of Radioactive Waste	300,000 out of 300,000	01.11.2019	32	Industrial contract		Climate change

Title	Principal Investigator (PI)	Co-PI(s)	Funding organisation; Program	Granted amount (CHF)	Starting date	Duration (Months)	Status	External institution(s) involved	Which sustainability challenges does the project tackle?
Support in geomechanical test analysis: planning, evaluation and synthesis of tests from cores of deep boreholes	Lyesse LALOUI		; NAGRA National Cooperative for the Disposal of Radioactive Waste	117,000 out of 117,000	01.05.2020	24	Industrial contract		Climate change
Triaxial tests for buffer bentonite on rock shear-Avenant 1	Lyesse LALOUI		; AINS (A-Insinnöörít Civil Oy)	0 out of 0	30.04.2020	12	Industrial contract		Climate change
Extension of research activities within the FE-M Task Force	Lyesse LALOUI		; NAGRA National Cooperative for the Disposal of Radioactive Waste	50,000 out of 50,000	01.07.2021	18	Industrial contract		Climate change
Extension of research activities of the LMS/EPFL activities for studying hydraulic and 2-phase flow behaviour of NUMO cores	Lyesse LALOUI		; NAGRA National Cooperative for the Disposal of Radioactive Waste	30,000 out of 30,000	01.10.2021	3	Industrial contract		
The unseen processes of enhanced weathering.	LALOUI Lyesse		Divers; CLIMACT	40,790 out of 49,833	01.11.2021	12	Ongoing	Université de Lausanne (UNIL), CH (Swiss Universities and Research Centers)	Climate change

Title	Principal Investigator (PI)	Co-PI(s)	Funding organisation; Program	Granted amount (CHF)	Starting date	Duration (Months)	Status	External institution(s) involved	Which sustainability challenges does the project tackle?
New insights in the analysis and prediction of the mechanical behavior of compacted expansive clays as engineered barriers	LALOUI Lyesse		FNS; FNS-Project Funding	672,139 out of 672,139	01.11.2021	48	Ongoing		Climate change
Phase 27 - Experimental assessment of shale properties for safe geological CO2 storage	LALOUI Lyesse		Non lucr.; Mont Terri	10,000 out of 10,000	01.08.2021	12	Ongoing		Climate change
Enerdrape : Transforming underground parking into heat exchangers	Peltier Margaux Marie Valérie	Peltier Margaux Marie Valérie	FNS; BRIDGE	178,912 out of 178,912	01.11.2020	19	Ongoing		Climate change Digitalization of cities and infrastructure Urbanization and territorial development
Construction & Environmental Biocementation in REal World Applications	LALOUI Lyesse		H2020; Excellent Science	162,150 out of 162,150	01.02.2021	18	Ongoing		Climate change Urbanization and territorial development
European Joint Programme on Radioactive Waste Management	GARCIA Marie	LALOUI Lyesse	H2020; Other	273,862 out of 35,142,221	01.06.2019	60	Ongoing		Climate change
Comportement Thermo-Hydro-Mechanique du Callovo-Oxfordien sous chargement thermique	LALOUI Lyesse		INT Governmental; ANDRA	307,500 out of 307,500	01.08.2019	48	Ongoing		Climate change

Title	Principal Investigator (PI)	Co-PI(s)	Funding organisation; Program	Granted amount (CHF)	Starting date	Duration (Months)	Status	External institution(s) involved	Which sustainability challenges does the project tackle?
BIOGEOS - Bio-mediated Geo-material Strengthening for engineering applications	LALOUI Lyesse		H2020; Excellent Science	2,991,544 out of 2,991,544	01.11.2018	66	Ongoing		Climate change Urbanization and territorial development
BEACON - Bentonite Mechanical Evolution	Ferrari Alessio	LALOUI Lyesse	Autres EU; Euratom	268,193 out of 4,131,368	01.06.2017	60	Ongoing		Climate change
Understanding the long-term role of seals in CO2 sequestration	Stavropoulou Eleni		; FNS- Ambizione	849,728 out of 849,728	01.11.2021		Pending		Climate change

Other funded research projects

Empty category

Funded equipment

Empty category

Research facilities

Empty category

Awards

Empty category

Publications & Presentations

Resources retrieved from Infoscience

Journal articles

Data	Peer reviewed	Key	Which sustainability challenges does the publication tackle?
Terzis D., Monitoring innovation metrics in construction and civil engineering: Trends, drivers and laggards , in Developments in the Built Environment , vol. 9, p.100064 , 2021-12-02, Abstract: yes, Status: published	✓		Climate change Digitalization of cities and infrastructure Urbanization and territorial development
Saracho A. C., Lucherini L., Hirsch M., Peter H. M., Terzis D., Amstad E., Laloui L., Controlling the calcium carbonate microstructure of engineered living building materials , in Journal Of Materials Chemistry A , vol. 9, num. 43, p.24438-24451 , 2021-10-29, Abstract: yes, Status: published	✓		Climate change Urbanization and territorial development
Zannin J., Ferrari A., Kazerani T., Koliji A., Laloui L., Experimental analysis of a thermoactive underground railway station , in Geomechanics for Energy and the Environment , p.100275 , 2021-10-19, Abstract: yes, Status: published	✓		Climate change Digitalization of cities and infrastructure Urbanization and territorial development
Kim J., Lorenzoni F., Salvalaggio M., Valluzzi M. R., Seismic vulnerability assessment of free-standing massive masonry columns by the 3D Discrete Element Method , in Engineering Structures , vol. 246, p.113004 , 2021, Abstract: yes, Status: published	✓		Urbanization and territorial development
Bosch Llufriu J. A., Ferrari A., Laloui L., Coupled hydro-mechanical analysis of compacted bentonite behaviour during hydration , in Computers and Geotechnics , vol. 140, p.104447 , 2021-09-15, Abstract: yes, Status: published	✓		Climate change
Bourhis P., Cousin B., Rotta Loria A. F., Laloui L., Machine learning enhancement of thermal response tests for geothermal potential evaluations at site and regional scales , in Geothermics , vol. 95, p.102132 , 2021-05-19, Abstract: yes, Status: published	✓		Digitalization of cities and infrastructure Urbanization and territorial development
Houhou R., Sutman M., Sadek S., Laloui L., Microstructure observations in compacted clays subjected to thermal loading , in Engineering Geology , vol. 287, p.105928 , 2021, Abstract: yes, Status: published	✓		Climate change
Crisci E., Ferrari A., Giger S. B., Laloui L., Effect of the mineralogical composition on the elastoplastic hydromechanical response of Opalinus Clay shale , in International Journal of Rock Mechanics and Mining Sciences , vol. 143, p.104747 , 2021-05-23, Abstract: yes, Status: published	✓		Climate change
Laloui L., Sutman M., Experimental investigation of energy piles: From laboratory to field testing , 7th International Symposium on Deformation Characteristics of Geomaterials (IS-Glasgow), Glasgow, SCOTLAND, Jun 26-28, 2019, in Geomechanics For Energy And The Environment , vol. 27, p.100214 , Abstract: yes, Status: published	✓		Climate change Urbanization and territorial development
Zannin J., Ferrari A., Pousse M., Laloui L., Hydrothermal interactions in energy walls , in Underground Space , vol. 6, num. 2, p.173-184 , 2021-04-01, Abstract: yes, Status: published	✓		Climate change Urbanization and territorial development
Asem P., Fuselier H., Labuz J. F., On a Four-Parameter Linear Failure Criterion , in Rock Mechanics And Rock Engineering , vol. 54, p.3369–3376 , 2021, Abstract: no, Status: published	✓		Climate change

Data	Peer reviewed	Key	Which sustainability challenges does the publication tackle?
Minardi A., Giger S. B., Ewy R. T., Stankovic R., Stenebraten J., Soldal M., Rosone M., Ferrari A., Laloui L., Benchmark study of undrained triaxial testing of Opalinus Clay shale: Results and implications for robust testing , in <i>Geomechanics For Energy And The Environment</i> , vol. 25, p.100210 , 2021, Abstract: yes, Status: published	✓		Climate change
Adinolfi M., Laloui L., Aversa S., Rotta Loria A. F., Experimental and numerical investigation of the thermo-mechanical behaviour of an energy sheet pile wall , in <i>Geomechanics For Energy And The Environment</i> , vol. 25, p.100208 , 2021-03-01, Abstract: yes, Status: published	✓		Climate change Urbanization and territorial development
Garbellini C., Laloui L., Soil-structure interaction of surface footings , in <i>Computers and Geotechnics</i> , vol. 134, p.104103 , 2021-03-21, Abstract: yes, Status: published	✓		Urbanization and territorial development
Stavropoulou E., Dano C., Boulon M., Shear Response of Wet Weak Carbonate Rock/Grout Interfaces Under Cyclic Loading , in <i>Rock Mechanics and Rock Engineering</i> , vol. 54, p.2791–2813 , 2021-03-15, Abstract: yes, Status: published	✓		Climate change Urbanization and territorial development
Minardi A., Stavropoulou E., Kim T., Ferrari A., Laloui L., Experimental assessment of the hydro-mechanical behaviour of a shale caprock during CO2 injection , in <i>International Journal of Greenhouse Gas Control</i> , vol. 106, p.103225 , 2021-01-19, Abstract: yes, Status: published	✓		Climate change
Tuttolomondo A., Ferrari A., Laloui L., Generalized effective stress concept for saturated active clays , in <i>Canadian Geotechnical Journal</i> , vol. 58, num. 11, p.1627-1639 , 2021, Abstract: yes, Status: published	✓		Climate change
Qiao Y., Tuttolomondo A., Lu X., Laloui L., Ding W., A generalised water retention model with soil fabric evolution , in <i>Geomechanics for Energy and the Environment</i> , vol. h25, p.100205 , 2021, Abstract: yes, Status: accepted	✓		Climate change
Garbellini C., Laloui L., Thermal stress analysis of energy piles , in <i>Géotechnique</i> , vol. 71, num. 3, p.260-271 , 2021, Abstract: yes, Status: published	✓		Climate change Urbanization and territorial development

Presentations & talks

Data	Key	Which sustainability challenges does the publication tackle?
Tuttolomondo A., Ferrari A., Laloui L., On the mechanical behavior of expansive porous media with consideration on chemical effects , <i>InterPore 2021 - 13th annual Meeting</i> , Online, 31 May 2021 - 4 June 2021, Abstract: yes, Status: accepted		Climate change

Posters

Data	Key	Which sustainability challenges does the publication tackle?
Tuttolomondo A., Ferrari A., Laloui L., On predicting pore fluid pressure changes in unsaturated porous media subject to undrained processes , <i>InterPore 2021 - 13th annual Meeting</i> , Online, 31 May 2021 - 4 June 2021, Abstract: yes, Status: accepted		Climate change

Technical reports

Data	Peer reviewed	Key	Which sustainability challenges does the publication tackle?
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Data	Peer reviewed	Key	Which sustainability challenges does the publication tackle?
Tuttolomondo A., Crisci E., Madaschi A., Laloui L., <i>Scale effects in Opalinus Clay: experimental investigations and theoretical analyses</i> , 2021, Abstract: no, Status: accepted			Climate change
Laloui L., <i>Energy Funding Programme 2013–2020, Final Report</i> , 2021-06-01, Abstract: yes, Status: published			Climate change Urbanization and territorial development

Theses

Data	Key	Which sustainability challenges does the publication tackle?
Ravera E., <i>Advisor(s): Laloui L., Cyclic thermomechanical behaviour of pile-soil interface and design methods for energy pile foundations</i> , Thèse EPFL, n° 9300, 2021, Abstract: yes, Status: published		Climate change Digitalization of cities and infrastructure Urbanization and territorial development
Bosch Llufrü J. A., <i>Advisor(s): Laloui L., Ferrari A., Studies on the mechanical evolution of compacted bentonite subjected to environmental actions</i> , Thèse EPFL, n° 9111, 2021, Abstract: yes, Status: published		Climate change
Garbellini C., <i>Advisor(s): Laloui L., Advances in the Soil-Structure Interaction Analysis -- from Surface Footings to Thermoactive Deep Foundations</i> , Thèse EPFL, n° 8240, 2021, Abstract: yes, Status: published		Urbanization and territorial development
Tuttolomondo A., <i>Advisor(s): Laloui L., Ferrari A., Effective stress for unsaturated active clays and in-situ effective stress estimation methodology</i> , Thèse EPFL, n° 8291, 2021, Abstract: yes, Status: published		Climate change

Other Open Resources

Other Open Teaching Resources

Empty category

Other Open Research Datasets

Empty category

Open research scripts and software

Empty category

Open Research scripts and software - Important recent additions

Empty category

Any other open research highlights from your lab ?

Empty category

Outreach

Current ongoing collaborations

People involved at ENAC & EPFL wide	Collaborating institution(s) (if not EPFL)	Additional information on cooperation partner(s)	Project topic/Description, Financial support (CHF) if any	Collaboration includes...	Which sustainability challenges does the collaboration tackle?
Laloui, Lyesse (LMS)	Swiss Competence Center for Energy Research (SCCER-SoE), CH (Swiss Universities and Research Centers)	Swiss Competence Center for Energy Research – Supply of Electricity (SCCER-SoE)	Geothermal energy and CO2 storage Link(s) to publication: 291705 ;	joint publication(s)	
Laloui, Lyesse (LMS); Ferrari, Alessio (LMS)	Chevron Corporation, US (Private sector)	CHEVRON	Geomechanical characterization of gas shales Link(s) to publication: 284482 ;	joint publication(s)	
Laloui, Lyesse (LMS); Ferrari, Alessio (LMS)	National Cooperative for the Disposal of Radioactive Waste (NAGRA), CH (Private sector)	NAGRA	Experimental and constitutive analysis of the Opalinus Clay shale Link(s) to publication: 284482 ; 285884 ;	joint publication(s)	

Innovation

Empty category

Distinguished work

Empty category

Appointments at other institutions

Name	Title	Institution	Additional information on institution
Ferrari, Alessio (LMS)	Associate professor	University of Palermo, IT (European Universities and Research Centers)	
Laloui, Lyesse (LMS)	Adjunct professor	Duke University, US (World Universities and Research Centers)	

Visiting scholars

Visitor	Home Institution	Additional information on home institution	Aim of visit, Duration
Di Donna, Alice	Université Grenoble Alpes, FR (European Universities and Research Centers)		April. Development of new approaches and methodologies for the geotechnical design of energy geostructures using machine-learning techniques and to adapt algorithms of machine learning able to predict the mechanical response of energy geostructures, starting from a training phase based on real scale data and numerical result (to be focused first on energy piles).

Visitor	Home Institution	Additional information on home institution	Aim of visit, Duration
Prodan , Iulia	Technical University of Cluj-Napoca, RO (European Universities and Research Centers)		3 months. Energetic geostructures.
Rotta Loria , Alessandro Francesco	Northwestern University, US (World Universities and Research Centers)		3 months. Geomechanics for energy production and storage and preparation of a new book.

Alumni

Alumnus	Level	First position out of lab	Country	Sector of activity
Clarà Saracho , Alexandra	Post doc	Research Fellow at University of Cambridge	UK	Academia
Crisci , Eleonora (LMS)	Post doc	Nesol, Numerical Engineering Solution	Switzerland	Start up, self-employed
Garbellini , Cristiano	PhD	Part of the De Cérenville team (engineering office)	Switzerland	Industry
Madaschi , Aldo (LMS)	Post doc	Director of Nesol - Numerical Engineering Solutions SARL	Switzerland	Start up, self-employed

Distinguished alumni

Alumnus	Achievement / Distinction
Peltier , Margaux Marie Valérie (LMS)	Enerdrape won the 10th edition of Startup Champions Seed Night. She is still working with us partially. https://www.epflalumni.ch/fr/enerdrape-wins-the-10th-edition-of-the-startup-champions-seed-night/

Organization of events

Date (month)	Location (if held in person)	Event title	Key people in lab involved	Description / URL
09/2021	EPFL	Seminar given by Prof. Enrique Romero Morales, UPC	Ferrari , Alessio (LMS)	Seminar on September 10th - "Some novel topics in experimental unsaturated soil mechanics: multi-physics and multi-scale outlooks".
11/2021	EPFL	Seminar given by Dr. Ighil Ameur, Cerema	Houhou , Roba (LMS)	Seminar on November 23 - "Cracking phenomenon of clays under indirect tensile test by bending: digital image correlation analysis".

Invited talks and contributions to events

Date (month)	Location (if held in person)	Event title	Key people in lab involved	Role / Talk title	Description / URL	Organizing institution (if not EPFL)	Additional information on organizing institution
11/2021	Madrid	VI Madrid Subterra Congress	Laloui , Lyesse (LMS)	Experimental analysis of a thermoactive underground railway station	Presentation on the results of an experiment on the CEVA railway line in Geneva to determine the heat exchange potential underground transport systems		https://www.madridsubterra.es/who-we-are/

Date (month)	Location (if held in person)	Event title	Key people in lab involved	Role / Talk title	Description / URL	Organizing institution (if not EPFL)	Additional information on organizing institution
09/2021	SwissTech Convention Centre	RENT Switzerland 2021	Laloui, Lyesse (LMS)	L'innovation en réponse aux défis énergétiques et environnementaux du secteur immobilier	La nécessité d'atteindre zéro net émissions de gaz à effet de serre d'ici 2050 et la stratégie énergétique de la Confédération constituent la base de la vision de la société à 2000 watts. En Suisse, le secteur du bâtiment représente la moitié des besoins énergétiques ainsi que des émissions de CO2. Ce domaine doit désormais jouer un rôle important dans la transition énergétique et la réalisation des objectifs climatiques. L'innovation permettra au monde de l'immobilier de se réinventer, avec entre autres, des matériaux de construction durables et des technologies d'énergies renouvelables. Cette conférence explore le processus de transfert du milieu académique, générateur de solutions durables, au monde de l'industrie.		http://www.rent-events.ch/

News / Actus

News channel	Title, Date	Heading	Authors	Links	Which sustainability challenges does the news tackle?
LMS	<i>Dr. Ferrari rejoint le comité de rédaction de revues renommées</i> 04.01.2021	À partir de janvier 2021, Dr. Alessio Ferrari rejoint les comités de rédaction des revues scientifiques « Géotechnique » et « Acta Geotechnica ».		Dr. Alessio Ferrari ; Publications by Dr. Ferrari	Climate change Urbanization and territorial development

News channel	Title, Date	Heading	Authors	Links	Which sustainability challenges does the news tackle?
LMS	« Nous avons une mission vis-à-vis de la Suisse et de la planète » 14.01.2021	Le professeur Lyesse Laloui, directeur du Laboratoire de mécanique des sols de l'EPFL et de la Section de Génie civil, a été élu en janvier membre de l'Académie suisse des sciences techniques. Une consécration pour cet ingénieur touche-à-tout, qui a fait de l'interdisciplinarité l'un des atouts de ses nombreuses recherches en géomécanique dans les domaines de l'environnement, des énergies renouvelables, ou encore du stockage du CO2.	Carlier Rémi	Académie suisse des Sciences techniques ; Du courant électrique pour stabiliser les sols peu perméables ; Laboratoire de Mécanique des Sols (LMS)	Climate change Urbanization and territorial development
LMS	Enerdrape, jeune spin-off du LMS dans le Magazine Bilan 25.02.2021	Dans sa dernière parution, le magazine Bilan s'est intéressé à trois start-up romandes qui proposent des solutions pour capturer, réduire ou valoriser le dioxyde de carbone, dont Enerdrape, la spin-off du laboratoire de mécanique des sols (LMS) qui développe des panneaux géothermiques.		About Prof. Laloui Research Group (LMS) ; Enerdrape website ; Link to article ; Margaux Peltier ; Prof. Lyesse Laloui	Climate change Urbanization and territorial development
LMS	MeduSoil à l'Entreprise Romande: bactéries et stabilisation des sols 14.03.2021	Plutôt que d'injecter du ciment pour stabiliser les sols, MeduSoil met à contribution des microorganismes qui, nourris avec une solution spéciale, créent un ciment naturel ; une technologie développée à l'EPFL - Un article paru dans l'Entreprise Romande, signé Pierre Cormon.		About Prof. Laloui Research Group (LMS) ; Dr. Dimitrios Terzis ; MeduSoil ; Prof. Lyesse Laloui	Climate change Urbanization and territorial development
LMS	Enerdrape, championne de la 10th Startup Champions Seed Night! 05.05.2021	Enerdrape, une spin-off du Laloui Research Group (LMS), cofondé par Margaux Peltier, Prof. Lyesse Laloui et Dr. Alessandro Rotta Loria, a obtenu la première place parmi 19 autres startups, à la 10ème édition de la Startup Champions Seed Night.		About Prof. Laloui Research Group (LMS) ; Enerdrape website ; Link to article ; Margaux Peltier ; Prof. Lyesse Laloui	Climate change Urbanization and territorial development
LMS	Prof. Laloui élu Vice-Président européen de la SIMSG pour 2022-2026 07.05.2021	Le Prof. Lyesse Laloui a été élu vice-président européen de la Société Internationale de Mécanique des Sols et de Géotechnique SIMSG (ou en anglais ISSMGE) par la majorité des 38 sociétés nationales Européennes. Il occupera ce poste entre 2022-2026.		About Laloui Research Group (LMS) ; Prof. Lyesse Laloui	
LMS	Promising findings on the potential of CO2 sequestration 23.07.2021	Carbon dioxide Capture and Storage (CCS) is a technology with great potential for reducing CO2 emissions in the atmosphere and thus mitigating climate change. Scientists from the Laboratory of Soil Mechanics at EPFL, the Rock Physics and Mechanics Laboratory at ETHZ, and the Digital Rocks Lab at Imperial College London teamed up within SCCER-SoE to study CO2 storage and provide a better understanding of its processes.		Link to the article	Climate change

News channel	Title, Date	Heading	Authors	Links	Which sustainability challenges does the news tackle?
LMS	<i>Vers une meilleure prédiction des glissements de terrains argileux</i> 24.08.2021	La Norvège connaît de dangereux glissements de terrain en raison de ses sols argileux. Dans le cadre de son projet de master en génie civil, Mathilde Metral a montré le potentiel d'amélioration du logiciel de prédiction actuellement en développement par les experts et expertes norvégiens.	Perroud Sandrine	Institut norvégien de géotechnique (NGI) ; Laboratoire de mécanique des sols (LMS)	Climate change
LMS	<i>Dr. Ferrari discute des glissements de terrain sur Heidi News</i> 31.08.2021	Dans son article du 28 août 2021, Florent Hiard aborde le sujet dérapant des glissements de terrains, où Dr. Alessio Ferrari du Laloui Research Group (LMS) intervient comme expert.		Dr. Alessio Ferrari ; Laloui Research Group (LMS) ; Link to article	Climate change
LMS	<i>Un rapport détaille le potentiel des géo-énergies en Suisse</i> 01.09.2021	Un fort potentiel de séquestration du CO2 dans les sols du Plateau suisse et un bel avenir à la géothermie de surface. Telles sont les deux principales conclusions du chapitre consacré aux géo-énergies inclus dans le Rapport final d'évaluation 2013-2020 d'Innosuisse. Les explications de Lyesse Laloui, professeur ordinaire en génie civil, l'auteur de ces pages et directeur de ce domaine de recherche.	Perroud Sandrine	Laboratoire de mécanique des sols (LMS) - EPFL	Climate change Urbanization and territorial development
LMS	<i>Laloui Research Group dans un article de l'AGEFI</i> 06.09.2021	La deuxième édition du salon Rent, catapulte l'assainissement énergétique sur le devant de la scène des professionnels de l'économie immobilière suisse. C'est durant cette rencontre que se distinguent des start-ups du LMS ainsi que son directeur, le Prof. Lyesse Laloui. Dans la dernière édition de l'AGEFI, « Les start-up proposent des solutions pour l'assainissement énergétique », un article signé Christian Affolter.		About Prof. Laloui Research Group (LMS) ; Enerdrape ; Geoeg ; Prof. Lyesse Laloui	Climate change Urbanization and territorial development
LMS	<i>Interview avec Prof. Laloui dans Le Temps</i> 07.09.2021	Le canton de Genève lance une campagne de cartographie de son sous-sol pour l'exploitation géothermique. C'est dans ce contexte qu'intervient Prof. Lyesse Laloui dans un entretien avec Le Temps pour répondre aux questions brûlantes à ce sujet.		About Prof. Laloui Research Group (LMS) ; Link to article ; Prof. Lyesse Laloui	Climate change Urbanization and territorial development
LMS	<i>La chaleur des parkings pour tempérer les appartements</i> 07.10.2021	Récupérer la chaleur des parkings souterrains pour chauffer les appartements : les panneaux muraux de la spin-off Enerdrape sont en phase de test dans le quartier de Sébeillon à Lausanne.	Carron Cécilia	Enerdrape ; Laboratoire de mécanique des sols	Climate change Digitalization of cities and infrastructure Urbanization and territorial development

News channel	Title, Date	Heading	Authors	Links	Which sustainability challenges does the news tackle?
LMS	Développer l'expertise des laboratoires pour le stockage de CO2 01.11.2021	Le réchauffement de la planète dû à l'activité humaine a des répercussions sur différentes régions du monde, comme le souligne le dernier rapport du GIEC. Pour atténuer l'impact du changement climatique, des réductions drastiques et rapides des émissions de gaz à effet de serre sont nécessaires. Ce n'est qu'en mettant en œuvre un éventail de mesures ainsi qu'en traitant le changement climatique comme une véritable crise, que les objectifs fixés dans l'accord de Paris de 2015 pourront être atteints.		CO2 capture and storage ; Laloui's Research Group (LMS)	Climate change
LMS	La Suisse va-t-elle enfouir son CO2 ou l'exporter? 01.11.2021	Afin d'atteindre la neutralité carbone d'ici 2050, la Suisse devra choisir entre exporter le CO2 ou le stocker sous terre. Dans l'article publié par la Tribune de Genève et 24heures, les experts partagent leurs opinions sur les solutions possibles.		24heures ; Tribune de Genève	Climate change
LMS	Energy Geotechnics, SEG-2018-in high demand 22.11.2021	Energy Geotechnics has proven to be a highly successful publication with more than 72 thousand chapter downloads since first being published in 2019.		Energy Geotechnics	
LMS	Des solutions urbaines pour nos futurs besoins énergétiques 01.12.2021	Le professeur Lyesse Laloui a présenté le potentiel et les résultats d'un projet de mise en œuvre et d'exploration des structures énergétiques souterraines lors de la Conférence Subterra à Madrid.		Madrid Subterra website ; YouTube	Climate change Urbanization and territorial development

Services

EPFL committees and services

Name	Service	Role	Role in funding allocation
Ferrari, Alessio (LMS)	Doctoral School in Mechanics (EDME)	Commission member	no
Laloui, Lyesse (LMS)	Faculty Search Committee for a position of Professor in Digital Infrastructure	Member	no
Laloui, Lyesse (LMS)	Faculty Search Committee for a position of Professor in Human-Centric Emerging Mobility	Member	no
Laloui, Lyesse (LMS)	Faculty Search Committee for a position of Professor in Sustainable Civil Engineering	Member	no
Laloui, Lyesse (LMS)	Civil Engineering Section	Director	yes
Laloui, Lyesse (LMS)	Direction of the School of Architecture, Civil and Environmental Engineering (ENAC)	Member	yes

Other committees and services (national including the EPF domain, international...)

Name	Service	Role	Role in funding allocation
Ferrari, Alessio (LMS)	International School on "LAndslide Risk Assessment and Mitigation" (LARAM)	Member of the Scientific Committee	no
Ferrari, Alessio (LMS)	Journal Geomechanics for Energy and the Environment	Member of the Editorial Board	no
Ferrari, Alessio (LMS)	International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE) TC 308 "Energy Geotechnics"	Vicechair of the technical committee	no
Ferrari, Alessio (LMS)	International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE) TC 101 "Unsaturated Soils"	Member of the technical committee	no
Ferrari, Alessio (LMS)	Sixth EAGE shale workshop 2019, Bordeaux, France	Member of the Scientific Committee	no
Ferrari, Alessio (LMS)	International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE) TC 106 "Laboratory Testing"	Member of the technical committee	no
Laloui, Lyesse (LMS)	Faculty Search Committee for a position of Professor in Engineering Geology at ETHZ	Member	no
Laloui, Lyesse (LMS)	International Energy Agency Greenhouse R&D Technology Collaboration Program	Executive Committee representative for the Government of Switzerland	no
Laloui, Lyesse (LMS)	Swiss Competence Center for Energy Research - Supply of Electricity	Member of the executive committee	no
Laloui, Lyesse (LMS)	Acta Geotechnica	Member of Editorial Board	no
Laloui, Lyesse (LMS)	Chinese Journal of Geotechnical Engineering	Member of Editorial Board	no

Name	Service	Role	Role in funding allocation
Laloui , Lyesse (LMS)	European Journal of Environmental and Civil Engineering	Member of Editorial Board	no
Laloui , Lyesse (LMS)	Journal of Coupled Systems and Multiscale Dynamics	Member of Editorial Board	no
Laloui , Lyesse (LMS)	Environmental Geotechnics	Advisory Board Member	no
Laloui , Lyesse (LMS)	International Journal for Numerical and Analytical Methods in Geomechanics	Member of Editorial Board	no
Laloui , Lyesse (LMS)	International journal Geomechanics for Energy and the Environment	Editor-in-Chief	no
Laloui , Lyesse (LMS)	Swiss Academy of Engineering Sciences SATW	Member	no

Vision

Highlights / 8 key achievements

Highlights / Key achievements
CONSTRUCTION & ENVIRONMENTAL BIOCEMENTATION IN REAL WORLD APPLICATIONS A new Proof of Concept project started in 2021 under the BIOGEOS Advanced ERC Grant.
PROF. LYESSE LALOU elected as the Vice President, Europe of ISSMGE (International Society for Soil Mechanics and Geotechnical Engineering).
INNOSUISSE PROJECT In conjunction with Amberg engineering and funding from Innosuisse, a new project is assessing the interaction between ventilation and geothermal systems in energy tunnels.
SNSF GRANT This new project is aimed at improving our mechanical understanding of the behavior of compacted expansive clays as engineered barriers.
ENERDRAPE TECHNOLOGY TESTING UNDERWAY Enerdrape has begun assessing its panels to utilize the heat from underground parking lots to warm nearby apartments.
Continued growth of lab with addition of 6 new people

Goals

Goals

Goals

The LMS activities are designed to promote engineering solutions in the field of the alternative sources of energy, including nuclear waste disposal, geothermal energy and CO₂ sequestration.

The LMS activities will continue to cover education, research and technology transfer in the large field of Geomechanics. The vision aims at contributing to a sustainable development of our built and natural environment by addressing selected key questions with the highest possible academic standard, within transdisciplinary internal and international collaborations and through contacts with industry with long-term research focuses.

The research activities will focus on problems involving a variable environment and new and advances in existing technologies of energy production. These two areas: environment and energy are expected to dominate technological agenda for forthcoming years. The reason for that is two-fold: first there is world-wide crisis of environment endangerment related to the geosphere: soil and groundwater pollution by accidental spills, CO₂ emission driven reduction of fossil fuel usage and/or inadequate isolation of pollutants, and second there is a host of new sources of energy related to geosphere. In both cases, there is an emerging new fundamental research concerning the effects of chemical, thermal and biological variables on mechanical properties and mechanical variables of soils and shales, and vice versa the effects of mechanical variables as stress, strain, damage affecting chemical and biological, physical or thermal processes and properties that require a multi-disciplinary approach. The levels of these couplings are multiple and often poorly recognized.

Especially with nascent technologies related to the energy production it is rational to include the environmental considerations early in the phase of development rather than seek remedies post factum, or after the damage has been induced. This clearly may refer to production of natural gas from shales, the techniques of hydraulic and chemical fracturing, CO₂ sequestration technologies, nuclear waste isolation (long and short term), heat and fuel storage in the underground and under structures, geothermal fluid energy, energy from methane hydrates, oil production from high temperature, high pressure deposits, and many others. Effects of chemical and biological pollution on isolation geo-structures constitute a separate class of problems. Finally, technologies of chemical and biological improvement of mechanical and hydraulic quality of soils and shales involve knowledge and methods based on the same principles.

The intrinsic nature of coupling of chemical, biological, thermal and mechanical properties, variables and fields distinguishes the related problems from those in classical geomechanics. It is believed that continuing and establishing new research activities dedicated to these issues of Energy and Environmental Geomechanics is a great opportunity for LMS and ENAC.

Some examples of activities for the coming years would be in the following areas:

Geo-energy structure

Efforts are being devoted to better understand the physical mechanisms and phenomena characterising the operation of energy geostructures for ensuring an optimal geotechnical, structural and energy performance of such ground structures. The LMS has nowadays more than 10 years of experience on this scope and is internationally recognised by Universities and Companies as the leader research group in this field. The analyses that are being performed are focused on various aspects that characterise energy geostructures, including the non-isothermal behaviour of soils when subjected to cyclic temperature variations, the interaction (soil-structure) with the concrete composing these ground structures, the structural behaviour of the concrete itself subjected to temperature changes, the hydraulic aspects related to the fluid flow inside of the pipes embedded in the concrete that allow for the heat exchange between the soil and the ground structure, and the optimal practices for equipping the considered elements. It is considered that the exploitation of shallow geothermal energy for satisfying the energy needs of building environments in an environmentally-friendly way will increase and spread worldwide more and more in the foreseeable future. The LMS, through its expertise in this subject matter, aims at being the representative of this revolutionary approach.

Deep Geo-Energy

Advanced theoretical, experimental and computational knowledge was developed in the recent years at the LMS for assessing and predicting the behaviour of geomaterials subjected to changes in temperature and at different states of saturation. This state of the art expertise has been mainly applied in the fields of underground nuclear waste storage as well as the geothermal use of the building foundations. The research activities are now devoted to (i) the enhancement of the understanding of the thermo-hydro-chemical-mechanical behaviour of shales (including gas shales and host rock formations for waste disposal) and bentonites and the prediction of their long term behaviour, and (ii) the development of computational

Goals

design tools for geo-energy structures.

Several highly sophisticated and unique experimental tools were developed at the lab in the recent three years with an investment of about 1000.- Kfrs (from FNS, EPFL and industry). It is planned to develop the knowledge and the understanding on the behaviour of soils and shales in the light of the extreme loading conditions that the equipment allows. There is a huge room for fundamental research on the running of coupled thermo (until 150°C) –hydro (until 400 MPa of suction)-mechanical (until 30 MPa) testing as well as on the behaviour of the materials in such conditions. I would like also to extend the laboratory facilities serving the research to micro scale observations (i.e. neutron tomography) for a better insight on the fundamental physical mechanism governing the thermo-hydro-mechanical behaviour of the involved materials.

Environmental Geomechanics

Efforts will be devoted to maintain the current research activities in the area of multi-physical coupling processes in soils at leading edge of technology with expertise in the fundamentals of soil mechanics.

LMS has a large tradition in the domain of landslides analysis. In the past years, early warning system methods have been developed. Climate change and its effects on earth equilibria, water budget are studied all around the world by thousands of researchers. Following this trend, the current researches at LMS focus on the effects of climate variations on the stability of slopes. To do so, interactions between the soil and the atmosphere have to be studied to understand the exchanges between the two systems. Making use of the foreseen climate changes, the aims of these researches would be to take a step forward in the management of the natural hazards by predicting the situation in the next century. As dry Summers as the 2015 are more often anticipated in the 21st century, the focus will be set on the mechanism of desiccation cracking in soils. The room for research on this phenomenon is extremely important and its implications on landfill liners integrity, stability of foundations, agriculture and stability of slopes have to be assessed.

The project of bio-improved soils currently carried out at LMS has proven great potential in building a sustainable, environmental-friendly method for stabilizing soils and preventing failures in a vast range of engineering problems. The project has already offered the chance for interdisciplinary collaboration between LMS and EML and offers common ground for collaboration with other ENAC laboratories. As a foreseen step, a pilot, large-scale application of the technique is planned in order to better design and suggest an efficient method, adaptable to the needs of the geotechnical problem.

CO2 storage

The financial support of Petrosvibri to the Chair allows the development of a deep knowledge in the area of CO2 storage. Experimental facilities devoted to this topic are developed. Also computational tools at the basin scale will be introduced for the analysis of the various scenarios.

These objectives would help the ENAC to strengthen its research and teaching profile and to play an important national and an international role in the most advanced and strategically important areas of research in Energy and Environmental Geomechanics.

Contribution to ENAC Strategy

Contribution to ENAC Strategy in 2021 (please refer to the presentation of ENAC strategy)

Contribution to ENAC Strategy

LMS continues its ongoing research, development and innovation into climate change anticipation, mitigation and adaptation solutions. It does so by not only examining the global challenges of atmospheric carbon but also attempting to address sustainable energy and the built environment developing new, sustainable construction products and renewable and recoverable energy solutions for the next generation of urban design and integrated energy systems.

Planned contribution to ENAC Strategy for the upcoming year(s)

Planned contribution to ENAC Strategy for the upcoming year(s)

Planned contribution to ENAC Strategy for the upcoming year(s)

The LMS will continue to develop sustainable solutions to address climate change and modern cities through the ongoing exploration of geo-materials, geotechnology and the innovation needed to ensure the spread of such technologies across the globe. ensuring safe waste disposal systems are advanced. LMS is also working to ensure its teaching curriculum incorporates a holistic approach to engineering and geo-mechanics employing lectures from other departments including geology.

Suggestions

Empty category

Others

Empty category

The activity report has not been validated by the head of the unit and can still be modified.

Printed 18.01.2023 by **Smith, Brendan** (LMS)