0. Introduction

At the request of Dean Parlange dated Feb. 6th, 2009, we have addressed below the five questions concerning the activities of the Laboratory of Soil Mechanics (LMS) in 2008.


1.1 Courses offered and student numbers;

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Instructor</th>
<th>Section ; number of hours</th>
<th>Level, semester</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geomechanics</td>
<td>L. Laloui</td>
<td>Génie civil, 42h</td>
<td>Ms, 1&amp;3</td>
<td>12</td>
</tr>
<tr>
<td>Ecoulements souterrains</td>
<td>L. Laloui</td>
<td>Génie civil, 28h</td>
<td>Bs, 4</td>
<td>52</td>
</tr>
<tr>
<td>Mécanique des sols</td>
<td>L. Laloui</td>
<td>ELSTE (Uni. Lausanne &amp; Genève), 21h</td>
<td>Ms, 2</td>
<td>15</td>
</tr>
<tr>
<td>Environmental geomechanics</td>
<td>L. Laloui</td>
<td>Doctoral school, 28h</td>
<td>Ph.D</td>
<td>10</td>
</tr>
<tr>
<td>Soil Mechanics 2</td>
<td>L. Laloui</td>
<td>MAS Tunnelling, 9h</td>
<td>MAS</td>
<td>10</td>
</tr>
<tr>
<td>Mécanique des sols</td>
<td>L. Vulliet</td>
<td>Génie civil, 42h</td>
<td>Bs, 3</td>
<td>58</td>
</tr>
<tr>
<td>Soil Mechanics</td>
<td>L. Vulliet</td>
<td>MAS Tunnelling, 9h</td>
<td>MAS</td>
<td>10</td>
</tr>
<tr>
<td>Géotechnique et Fondations</td>
<td>M. Gencer &amp; G. Gruaz</td>
<td>Sciences et Ingénierie de l'Environnement, 42h</td>
<td>Bs 5</td>
<td>10</td>
</tr>
<tr>
<td>Géotechnique et mécanique des sols</td>
<td>G. Steinmann</td>
<td>HES Fribourg</td>
<td>Bs 3</td>
<td>15</td>
</tr>
<tr>
<td>Protection des sols</td>
<td>G. Steinmann</td>
<td>HES Fribourg</td>
<td>Bs 5</td>
<td>15</td>
</tr>
</tbody>
</table>

1.2 Outside teaching and workshops


2. L. Laloui: “Advanced Geomechanics for Landslides”. 8 hours teaching at the European workshop on Hazard analysis (slide, rockfall, debris flow, snow avalanche), Lausanne, November 26-30, 2007, 60 students

3. L. Laloui: “Geomechanical modeling of a natural slope affected by multiple slip surface failure mechanisms”. 3 hours teaching at the European Intensive course on Quantitative Risk Assessment and Risk management, Barcelona (Spain), September 2008, 70 students
4. H. Péron, “Mécanique des sols avancée - Sols non saturés: Phénomène de dessiccation des sols”. 3 hours teaching at ENSG Nancy (Ecole Nationale Supérieure de Géologie, 3ème Année - option Géotechnique), June 2008, 28 students

1.3 PhD students

(Completed PhD thesis)

1. Koliji A., PhD student (L. Vulliet advisor), Title: Mechanical behaviour of unsaturated aggregated soils (successful exam in January 2008)
   *Nominated for the EPFL award of best thesis 2008*

2. Péron H., PhD student (L. Laloui advisor), Title: Desiccation cracking of soils (successful exam in January 2008)
   *Nominated for the EPFL award of best thesis 2008*

3. François B., PhD student (L. Laloui advisor), Title: Constitutive modelling of unsaturated soils and hydro-mechanical couplings (successful exam in September 2008)

4. Nuth M., PhD student (L. Laloui advisor), Title: Advanced modelling of unsaturated soils, constitutive and hydro-mechanically coupled finite element analysis (Public defence will be in April 2nd, 2009)
   *Nominated for the EPFL award of best thesis 2009
   Selected by the EPFL Research Commission for the Chorafas award 2009*

(names and stage of progress indicating expected date of completion)

5. Obraz R., PhD student (L. Vulliet advisor), Title: Algorithm for soil parameter determination based on in-situ testing (in progress, to be completed in summer 2009)

6. Shokri N., PhD student (L. Laloui, co-advisor), Title: dominant mechanisms controlling evaporation process (in progress, to be completed in summer 2009)

7. Rascol E., PhD student (L. Vulliet advisor), Title: Soil Dynamics (in progress, to be completed in winter 2009)

8. Chalindar S., PhD student (L. Laloui advisor), Title: Advanced modelling of the behaviour of clays: Time-dependency, chemical reactions and bacterial activities (in progress, to be completed in 2010)

9. Rizzi M., PhD student (L. Laloui advisor), Title: Characterization and constitutive modelling of the behaviour of granular bentonite during thermo-hydro-mechanical processes (in progress, to be completed in 2010)

10. A. Battiato, PhD student (L. Laloui advisor), Title: Characterization and modelling of effects of wheeling on topsoil (in progress, to be completed in 2012)

11. J. Eichenberger, PhD student (L. Laloui advisor), Title: Behaviour of large landslides (in progress, to be completed in 2012)

1.4 Ms students

1. Dura A., Ms student (L. Laloui advisor), Title: Post-thermal aging of soils (successful exam in January 2009)
2. Adel Y., Ms student (L. Laloui advisor), Title: Etude du comportement mécanique des matériaux granulaires compactés non saturés sous chargements cycliques (successful exam in June 2008)

3. Passarotto M., Ms student (L. Laloui co-advisor), Title: Coupled hydro-thermo-mechanical analysis of deep radioactive waste disposals (successful exam in June 2008)

4. Akry A., Ms student (L. Laloui co-advisor), Title: Recharge de nappes en afrique du nord - barrages collinaires de rétention de crue, barrages infero-flux – souterrains à travers le lit d’un oued (successful exam in June 2008)

5. Eichenberger J., Ms student (L. Laloui co-advisor), Title: dimensionnement de galeries en charge en milieu anisotrope (successful exam in June 2008)


(full title and link to InfoScience)

2.1 Journal Articles accepted and published in 2008

   http://infoscience.epfl.ch/record/102337

   http://infoscience.epfl.ch/record/114509

   http://infoscience.epfl.ch/record/128612

   http://infoscience.epfl.ch/record/104546

   http://infoscience.epfl.ch/record/118203

   http://infoscience.epfl.ch/record/125935

   http://infoscience.epfl.ch/record/121370

   http://infoscience.epfl.ch/record/118741
http://infoscience.epfl.ch/record/115072

http://infoscience.epfl.ch/record/128609

http://infoscience.epfl.ch/record/118641

http://infoscience.epfl.ch/record/124852

http://infoscience.epfl.ch/record/118500

http://infoscience.epfl.ch/record/134820

http://infoscience.epfl.ch/record/129017

http://infoscience.epfl.ch/record/126460

http://infoscience.epfl.ch/record/133587

http://infoscience.epfl.ch/record/121378

http://infoscience.epfl.ch/record/128547
2.2 Book Chapters (2008)


2.3 Proceedings (2008)


   http://infoscience.epfl.ch/record/125627

   http://infoscience.epfl.ch/record/125311

   http://infoscience.epfl.ch/record/125313

   http://infoscience.epfl.ch/record/121437

   http://infoscience.epfl.ch/record/130529

   http://infoscience.epfl.ch/record/134821

   http://infoscience.epfl.ch/record/134822

2.4 Other (2008)

   http://infoscience.epfl.ch/record/124795

2.5 Keynote and Invited Presentations (2008)


2. L. Laloui - “Geomechanical modeling of a natural slope affected by multiple slip surface failure mechanisms”. Invited lecture at the Intensive course on Quantitative Risk Assessment and Risk management, Barcelona (Spain), September 2008.


1. Laloui, L. Swisselectric research (2 years project – 116Kfrs) - Title: Energetic geostructures: a sustainable technology for heating and cooling of buildings.
2. Laloui, L., Swiss Federal Office of Roads (1 year project – 87 Kfrs) - Title: Thermo-Prefabricated Vertical Drain for in-situ consolidation of soils.
3. Laloui, L. Swiss Federal Office of Energy (1 year project – 60 Kfrs) - Title: Innovative improvements of thermal response tests, Phase 2.
4. Laloui, L. National Cooperative for the Disposal of Radioactive Waste, NAGRA (4 years project – 189 Kfrs) - Title: Characterisation and constitutive modeling of the behaviour of granular bentonite during THM precesses.
6. Laloui, L. Marie Curie Actions - Research Training Network, European Union (1 year project, 121 Kfrs) - Title: Mountain risks.
7. Laloui, L., Bonnard, Ch., Swiss Competence Center Environment and Sustainability (3 years project – 97 Kfrs) - Title: Triggering of Rapid Mass Movements in Steep Terrain.
8. Laloui, L., Swiss Academy of Engineering Sciences (2 years project – 10 Kfrs) - Title: Thermo-hydro-mechanical behaviour of unsaturated soils.
10. Laloui, L., National Science Foundation – R’Equip programme (460 Kfrs) - Title: Experimental investigations of soils in the context of underground nuclear waste disposal.
11. Laloui, L., Mont Terri Consortium (45 Kfrs) - Title:Experimental and numerical study on damage initiation in the context of the analysis of excavation damage zone along tunnels And Analysis of Opalinus clay self sealing.
12. Diserens E., L. Laloui, A. Alaoui, H.P. Lorenz, A. Szymanski, Swiss Federal Office of Environment (138 Kfrs, 3 years) - Title: Zugleistung, Schlupf und Oberbodengefährdung bei Antriebsreifen.
13. Vulliet, L., Nguyen, V., Laloui, L., Swiss National Science Foundation FNS (3 years project – 172 Kfrs) - Title: Dynamic Properties of Granular Soils and Behavior of Earth Structures under Strong Earthquake Motion.

4. Awards

14. Excellent Contributions Award of the International Association for Computer Methods and Advances in Geomechanics, IACMAG, 2008.

This is awarded to individuals who have made significant contributions in research, academic activities and professional service in the interdisciplinary area of Geomechanics.
5. Administrative efforts at ENAC or EPFL (2008)

1. L. Laloui: Director of the doctoral programme in Mechanics.
2. L. Laloui: Member of the research committee for the School of Architecture, Civil and Environmental Engineering of the EPFL (ENAC).
4. L. Vulliet: Member, Foundation Council of the Presses Polytechniques et Universitaires Romandes (PPUR), Lausanne (1995-Present)

6. Objective 2009

Vision
The Soil Mechanics Laboratory (LMS) focuses its activities of education, research and technology transfer in the field of Geomechanics. Its 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 collaborations and through contacts with industry.

Activities
LMS offers courses from Bs to PhD level in soil mechanics, mechanics of porous media, foundation engineering and groundwater seepage.

Research activities will mainly concentrate on:

- **mechanics of geomaterials**, including constitutive modelling, mechanics of porous media and mixtures, cemented, fissured and structured soils, unsaturated soils, multiphase flow in deformable porous media, cyclic loading, elasto-visco-plasticity, laboratory testing, image processing for mechanical testing;

- **environmental geomechanics** applied to geological disposal of nuclear and hazardous waste, as well as energetic geostuctures; thermo-hydro-mechanical coupling effects, clay barriers, dessication cracking;

- **numerical modelling of geomaterials** using finite differences and finite elements, algorithms for non-linear coupled problems, optimization procedures, back- and inverse analysis, modelling of landslides;

- **management of natural hazards**, including monitoring, analysis of landslides and debris flow, risk management.

LMS will continue to active in technology transfer and outreach by offering laboratory tests, numerical modelling and expertise work.

For 2009, the aim is at developing a unique scientific way of thinking in the rapidly expanding field of multi-physics coupled processes in porous materials. This concerns the study of the behaviour of geomaterials with all the complexity of their multi-physical and often multi-scale nature and of their environment. Our framework might be extended to biological processes in the context of an ERC proposal.

We intend to form a strong scientifically competent group of interest in Environmental Geomechanics with a distinct modern focus. Such a group could be an international leader in the area that is gaining momentum worldwide.

Prof. Lyesse Laloui, director of LMS

Lausanne, February 13rd, 2009