DEPARTMENT OF
MATERIALS, ENVIRONMENTAL SCIENCES AND ENGINEERING AND URBAN PLANNING
Via Brecce Bianche 12, 60131 Ancona (Italy)

AREA: GEOTECHNICAL ENGINEERING

DEPARTMENT OF MATERIALS, ENVIRONMENTAL SCIENCES
AND ENGINEERING AND URBAN PLANNING
Via Brecce Bianche 12, 60131 Ancona (Italy)

AREA: GEOTECHNICAL ENGINEERING

The Geotechnical Group is a group of Civil and Environmental Engineers very active in the fields of Soil Mechanics, Environmental Geotechnics and Geotechnical Engineering. Our research work on Soil Mechanics addresses the mechanical behavior of natural soils with emphasis on geologically complex soils, so much involved in landslides phenomena throughout Italy and in the design of new infrastructures. Research in Environmental Geotechnics includes studies on new geomaterials, on the safety of contaminated lands, on geotechnical stabilization and re-use of dredged materials. For all the above topics aspects of Geotechnical Engineering are addressed. These include soil-structure interaction for earth retaining structures and foundations, seismic analysis of geotechnical structures, numerical modelling of discontinuous ground, ground improvement with lime or cement, design of hydraulic barriers for contaminated land. Experimental work benefit of the soil mechanics laboratory and the environmental geotechnics laboratory. The numerical analysis for the geotechnical engineering studies is carried out by up-to-date numerical codes, 2D and 3D, with advanced constitutive models of the soil.

Research Topics and Activities

- Limit State Design and Seismic Design
- Numerical Modelling and Monitoring
- Port engineering
- Forensic engineering (Judicial support and consultancy)
- Land reclamation
- Contaminated sites
- Hydraulic barriers
- Soil improvement (soil cement mixture, lime stabilization, passive piles, jet grouting)

People

ACADEMIC STAFF			
GIUSEPPE SCARPELLI	EVELINA FRATALOCCHI	FRANCESCO MAZZIERI	EVGHENIA SAKELLARIADI
IVO BELLEZZA	VIVIENE M.E. FRUZZETTI	MARTA DI SANTE	PAOLO RUGGERI
SESSIONAL LECTURER	**TECHNICAL STAFF**	**POST-DOC. FELLOWS**	**PhD STUDENTS**
ERIO PASQUALINI	JONATHAN DOMIZI	ANTONIO FERRETTI MIRKO FELICI	FEDERICA PASQUALINI DAVIDE BERNARDO

Laboratories

1. **SOIL MECHANICS** director: **GIUSEPPE SCARPELLI**
2. **ENVIROMENTAL GEOTECHNICS** director: **EVELINA FRATALOCCHI**

Teaching

Bachelor degree

Building Engineering
- Geotechnics

Civil and Environmental Eng.
- Geotechnics
- Foundations

Master degree

Building Engineering
- Foundation and earth retaining structures

Enviromental Engineering
- Enviromental Geotechnics
- Slope Stability

Civil Engineering
- Geotechnical Design
- Geotechnical Design 2
- Ground improvement
- Geotechnical Modelling

5yrs Master Degree

Building Engineering and Architecture
- Geotechnics

Professional Degree

Building Technics and land management
- Basics of Geotechnics

DEPARTMENT OF MATERIALS, ENVIRONMENTAL SCIENCES
AND ENGINEERING AND URBAN PLANNING
Via Brecce Bianche 12, 60131 Ancona (Italy)

AREA: GEOTECHNICAL ENGINEERING

Geotechnical Group

Academic Staff

Prof. Giuseppe Scarpelli
Full Professor
g.scarpelli@staff.univpm.it

Prof. Evelina Fratalocchi
Associate Professor
e.fratalocchi@staff.univpm.it

Prof. Francesco Mazzieri
Associate Professor
f.mazzieri@staff.univpm.it

Dr. Evghenia Sakellariadi
Assistant Professor
e.sakellariadi@staff.univpm.it

Dr. Ivo Bellezza
Assistant Professor
i.bellezza@staff.univpm.it

Dr. Viviene M.E. Fruzzetti
Assistant Professor
v.m.e.fruzzetti@staff.univpm.it

Dr. Marta Di Sante
Assistant Professor
m.disante@staff.univpm.it

Dr. Paolo Ruggeri
Assistant Professor
p.ruggeri@staff.univpm.it

Sessional Lecturer

Prof. Erio Pasqualini
e.pasqualini@staff.univpm.it

Technical Staff

Dr. Jonathan Domizi
j.domizi@staff.univpm.it

Post Doctoral Fellows

Dr. Mirko Felici
m.felici@staff.univpm.it

Dr. Antonio Ferretti
a.ferretti@pm.univpm.it

PhD Research Students

Dr. Federica Pasqualini
f.pasqualini@pm.univpm.it

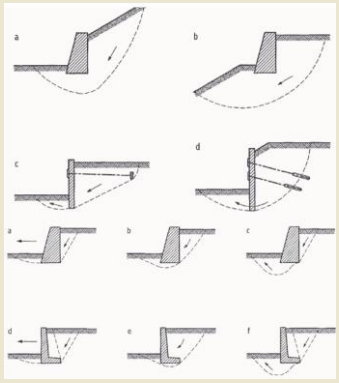
Dr. Davide Bernardo
d.bernardo@pm.univpm.it

RESEARCH TOPICS AND ACTIVITIES

Limite state and seismic designs

Limit state design

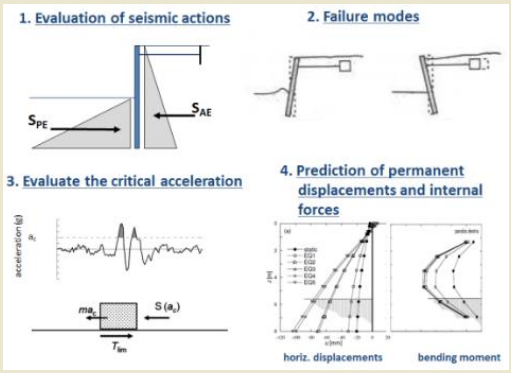
This research originates from recent changes in European and Italian Codes for construction, being the group coordinator part of the European Committees for Eurocode 7.
This activity implies detailed studies on safety definition and quantification for many different geotechnical structures in variable grounds. To inform the writing of the codes, a lot of practical testing of the logic implied by the Code is needed, requiring the use of various approaches and calulation methods in different geotechnical situations. The analysis of geotechnical structures is carried out by adopting both traditional and advanced analyses and by using dedicated software.

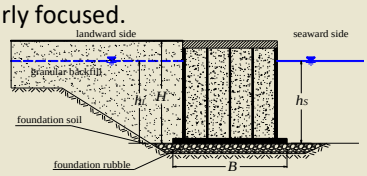


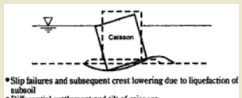
STAFF CONTRIBUTING TO THE TOPIC: G. Scarpelli, I. Bellezza, E. Sakellariadi, V.M.E. Fruzzetti, P. Ruggeri

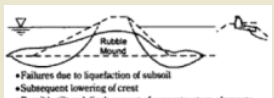
Performance based design in seismic design

The design of a geotechnical structure under seismic loading is frequently carried out by the pseudostatic approach, checking the system against all possible geotechnical and structural ultimate limit states. Keeping in mind the importance of strength hierarchy and ductility concepts when designing for seismic conditions, the research focuses on the possibility that current practice can be used efficiently for seismic design if Performance Based Design principles are included. Seismic design approaches for waterfront structures are particularly focused.









STAFF CONTRIBUTING TO THE TOPIC: G. Scarpelli, I. Bellezza, V. M.E. Fruzzetti, P. Ruggeri

Forensic Engineering

Judicial support and consultancy

The geotechnical group has often been involved in consultancy activities in court cases consequence of failure or weird performance of real geotechnical structures.
This activity has been mostly commissioned as advisory contribution by Courts of Law, by public administrations, private companies or individuals.

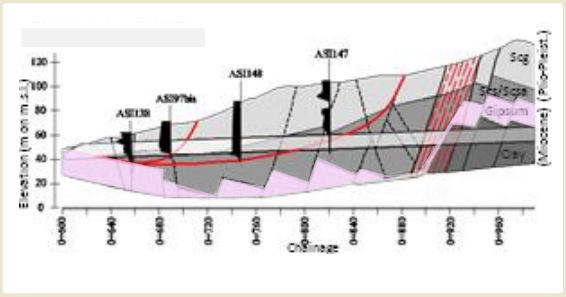
STAFF CONTRIBUTING TO THE TOPIC: G. Scarpelli, V.M.E. Fruzzetti, P. Ruggeri

RESEARCH TOPICS AND ACTIVITIES

Numerical Modelling and Monitoring

Landslides-prone area

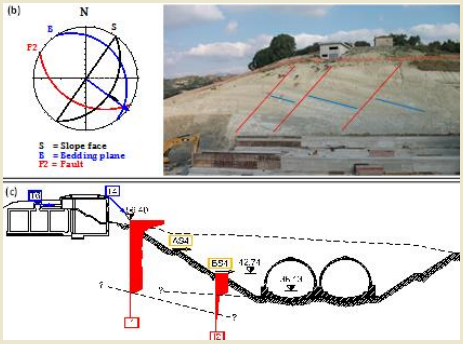
In recent years there has been strong motivation to modernize the infrastructural network in Italy including rail, roads and pipelines. Such impact can be very large if the geology of the area is complex and where soil deposits have been involved in quite recent tectonic activity. In such formations landslides can easily develop, so that routine design approaches are not appropriate for modelling the interaction with the infrastructure. The aim of this research is to analyze through the discussion of real examples of large infrastructures built in areas affected by slope instability processes how to optimize the site investigation to reduce and possibly eliminate the consequences and the costs of an inadequate design.



STAFF CONTRIBUTING TO THE TOPIC:G. Scarpelli, E. Fratalocchi, F. Mazzieri, I. Bellezza, E. Sakellariadi, M. Di Sante, V. M. E. Fruzzetti, P. Ruggeri, A. Ferretti

Works in structurally complex formations

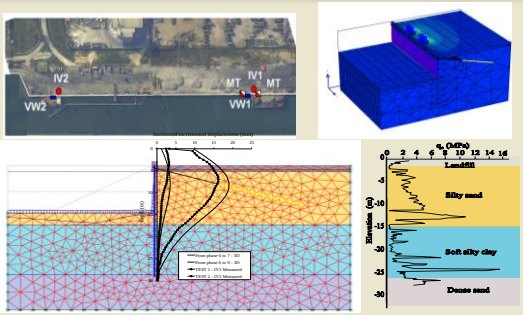
Many formations are affected by complex systems of joints, bedding planes and faults.
In these cases, the presence of shear bands, fissures, fractures, or other types of discontinuities within the soil mass is the main factor controlling the global stress-strain response of the soil mass. When this happens, it looks a better option to model directly the presence of the discontinuity within the soil mass. rather than to use a specific and complex constitutive law of the soil itself.
Starting from the experience gained by the Research Unit in the field, some specific case histories are analysed: deep excavations, anchored retaining structures and underground constructions. The research focuses also on the use of back analysis to interpret data from the monitoring.



STAFF CONTRIBUTING TO THE TOPIC: G. Scarpelli, E. Sakellariadi, V. M. E. Fruzzetti, P. Ruggeri

Port engineering

In order to ensure the development of large port infrastructures to allow the access to large cargo vessels, it is necessary to deepen the seabed. Research activities focus on the selection of the appropriate numerical scheme and of the soil constitutive modelling to better represent the observed behaviour of real cases.
Monitoring, back analysing of data, numerical modelling are the key issues for these studies



STAFF CONTRIBUTING TO THE TOPIC: G. Scarpelli, I. Bellezza, V. M. E. Fruzzetti, P. Ruggeri

RESEARCH TOPICS AND ACTIVITIES

Land reclamation and contaminated sites

Management and improvement of the mechanical properties of dredged sediments

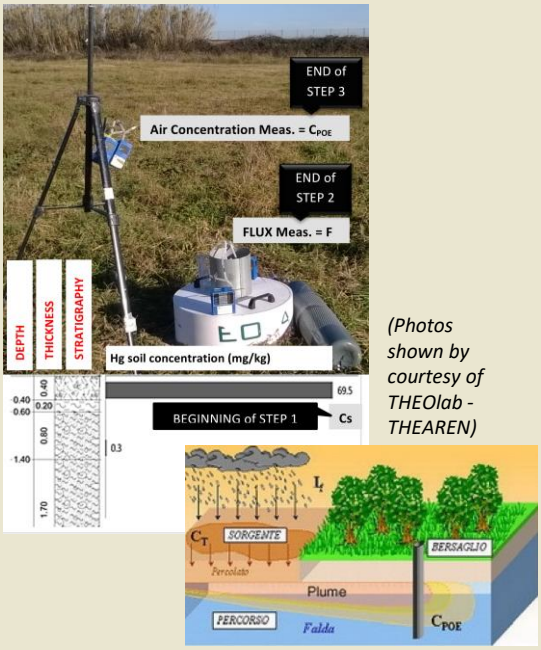
This topic deals with the optimization of the procedures and with the geotechnical aspects connected with containment structures of dredged sediments put in place by hydraulic filling technique. Moreover, consolidation of these sediments under their own weight is addressed together with the selection criteria for improving their mechanical performance.

STAFF CONTRIBUTING TO THE TOPIC: E. Fratalocchi, F. Mazzieri, M. Di Sante, M. Felici

Contaminated sites: characterization and remediation

Polluted sites characterization
Characterization of contaminated soils and groundwater in polluted sites, risk assessment and development of calculation tools for sensitivity analyses and migration models for contaminants (Visual Basic, Mathcad). In-situ measurement of vapor emissions and comparison with volatilization models, definition of ecological screening level for potentially contaminated soil.

Solidification/stabilization of contaminants in soil.
Aim of the research work is to evaluate the possibility of immobilizing contaminants on the solid matrix by means of binder addition. Moreover, multi-criteria analyses to identify the best remediation solution are applied to select in-situ/on-site techniques.



(Photos shown by courtesy of THEOlab - THEAREN)

STAFF CONTRIBUTING TO THE TOPIC: E. Fratalocchi, F. Mazzieri, M. Di Sante

.

RESEARCH TOPICS AND ACTIVITIES

Hydraulic barriers

CB mixtures for cut-off walls used in encapsulation of polluted soils

This study has been ongoing for more than a decade and aims at characterizing the hydraulic and mechanical properties of cement bentonite (CB) mixtures employed as hydraulic and pollutant barriers in cut-off walls for the encapsulation of polluted sites. The study analyzes the influence of intrinsic, construction-related and environmental factors on the hydraulic behaviour of the cut-off walls with time, with the purpose of optimizing the performance of the material. In particular, correlation has been established between the long-term hydraulic conductivity and type and dosage of the components. Furthermore, the study investigates the chemical compatibility of CB mixtures to sulphatic and acidic solutions, which represent the two main classes of potentially aggressive fluids for the considered materials. Special apparatus and testing protocols are used to carry out long-term permeation tests with liquid different than water; sorption of solutes to the CB solids can be separately investigated by means of batch testing. Permeation tests are interpreted by analytical and numerical models in order to assess the migration parameters of the pollutant species. The study has obtained important results on the behaviour of CB mixtures in aggressive conditions; a procedure has been developed that allows to estimate the durability of the material, based on laboratory tests which can be completed in times compatible with the design phase.

STAFF CONTRIBUTING TO THE TOPIC: E. Fratalocchi, F. Mazzieri, M. Di Sante

Geosynthetic clay liners, GCLs

Geosynthetic Clay Liners in aggressive conditions

The study concerns the behaviour of Geosynthetic Clay Liners regarding possible critical conditions for their hydraulic performances such as strong electrolyte solution of monovalent cations (e.g. seawater), calcium-rich solutions, acidic solutions. Migration phenomena and sorption of solutes (e.g. heavy metals) through GCLs are investigated by means of diffusion and column tests, with the purpose of accurate predictions of pollutant containment performance in the field.

Behaviour of modified bentonites

The study concerns the behaviour of novel bentonites treated with additives or modified at the structural scale (nano-composites) with the purpose of improving their properties in hydraulic or pollutant barriers. In particular this study addresses the impact of dry and wet cycles (which can occur in some applications) on the swelling and hydraulic response of bentonite.

STAFF CONTRIBUTING TO THE TOPIC: F. Mazzieri, E. Fratalocchi, M. Di Sante , D. Bernardo

RESEARCH TOPICS AND ACTIVITIES

Soil improvement

Soil Improvement with binders addition

Aim of the research work is to improve mechanical and hydraulic behavior of compacted mixtures of soils and binders for earthworks (e.g. road embankments, river banks), slope stabilization and sidewall liners in controlled landfills. The binders of concern are lime and cement.

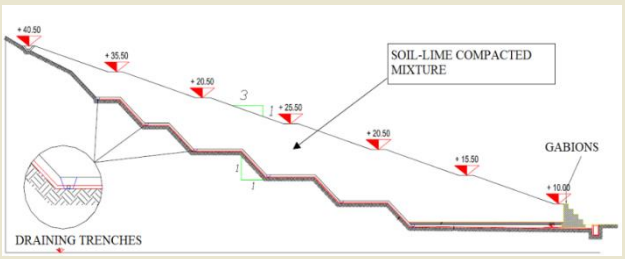
Cement capability in improving soil shear strength (irrespectively of soil type and as a function of cement amount) is well known; moreover, hydraulic conductivity of soils can be reduced or increased by binder addition as a function of soil type and type and amount of cement.

An experimental laboratory study was developed for many soils of different characteristics to consider a wide range of grain size distributions and different mineralogies. By means of statistical analysis, a prevision model of hydraulic conductivity as a function of variables linked to mineralogy, gradings and compaction energy was developed.

The research on lime stabilization is focused on time and mode of reactions between clayey soils and quicklime or hydrated lime, on the analysis of the effect of main variables of lime treatment on mechanical and hydraulic behavior of soils and on long term effect of lime stabilization. The analysis of micro-structure of lime-treated soils has been useful for interpretation of experimental results.

Correlations between shear strength parameters and main variables of lime treatment have been studied in order to optimize the mix-design procedure together with compaction and plasticity characteristics of treated soils.

A feasibility study of the stabilization of sensitive Finnish clay with quicklime has been carried out and is currently in progress.

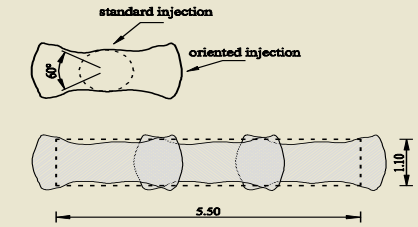


STAFF CONTRIBUTING TO THE TOPIC: E. Fratalocchi, F. Mazzieri, M. Di Sante , D.. Bernardo

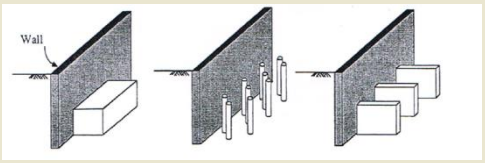
RESEARCH TOPICS AND ACTIVITIES

Soil improvement

Jet-grouting



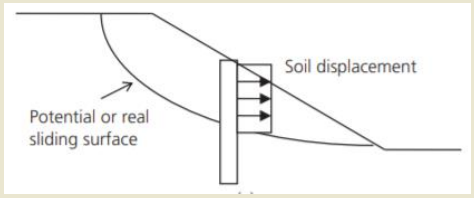
The design of Soil improvement is largely empirical when equivalent geotechnical parameters for the composite ground subjected to horizontal loading are needed. The research aims at evaluating the equivalent composite parameters of jet-grouting useful to perform numerical analyses that are representative of the performance of the improved ground. The results of the study allowed the production of design charts which correlate the density of the treatment and the stiffness of the composite for transversal loading.



STAFF CONTRIBUTING TO THE TOPIC: G. Scarpelli, V.M.E. Fruzzetti, P. Ruggeri

Optimization of passive piles design

The research is focused on the analysis of passive piles, i.e. piles loaded transversally by the movement of the sourrounding soil. A typical example of passive piles is represented by piles used to stabilize unstable slopes. The study is a very complex and challenging task because it involves a complicated soil-structure interaction mechanism which depends on the assumed soil movement distribution. As far as passive pile design is concerned some simplified models are analyzed based on different hypotheses on pile stiffness (rigid or flexible piles), soil conditions (fully elastic, fully plastic or elastic-plastic) and distribution of soil parameters with depth (homogeneous cohesive or non-cohesive soil, two-layer soil, etc). The research also involves the implementation of specific computer program to analyze both a passive pile embedded in a given soil stratigraphy and a generic slope stabilized with a row of piles using the traditional limit equilibrium methods modified to account for the pile soil interaction effect.



STAFF CONTRIBUTING TO THE TOPIC: I. Bellezza

DEPARTMENT OF MATERIALS, ENVIRONMENTAL SCIENCES
AND ENGINEERING AND URBAN PLANNING
Via Brecce Bianche 12, 60131 Ancona (Italy)

AREA: GEOTECHNICAL ENGINEERING

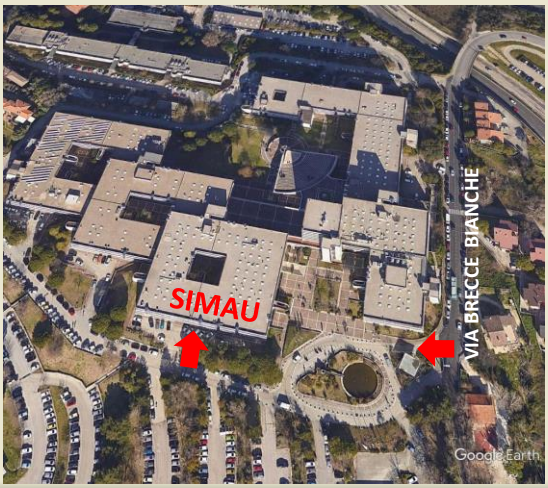
1. SOIL TESTING LABORATORY

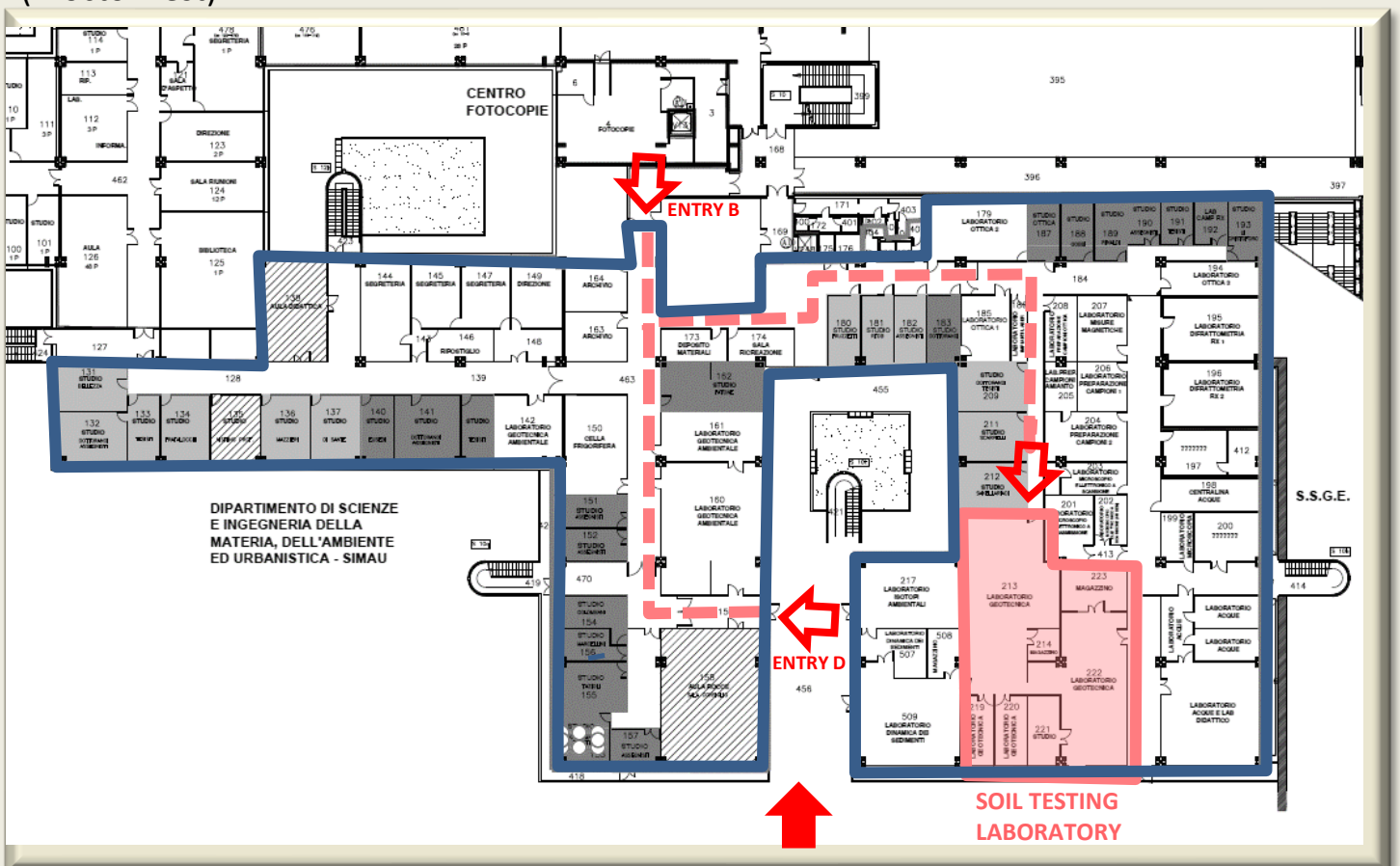
Director: PROF. GIUSEPPE SCARPELLI
Phone +390712204421, mail: g.scarpelli@univpm.it

LOCATION: POLO BELLUSCHI-LEVEL 155
ROOMS: 213, 214, 219, 220, 221, 222, 223

Short description:

The laboratory is able to provide physical and mechanical characterization of soils by standard testing and some advanced testing. The following tests are available: determination of physical parameters and classification (moisture content, bulk and dry density, particle density, Atterberg limits, particle size distribution) incremental oedometer consolidation test (oedometer IL), constant rate of strain test (oedometer CRS), direct shear test, triaxial compression tests (TxCIU, TxCID, UU), stress path triaxial testing, compaction test (Proctor Test).





DEPARTMENT OF MATERIALS, ENVIRONMENTAL SCIENCES
AND ENGINEERING AND URBAN PLANNING
Via Brecce Bianche 12, 60131 Ancona (Italy)

AREA: GEOTECHNICAL ENGINEERING

1. SOIL TESTING LABORATORY

Director: PROF. GIUSEPPE SCARPELLI
Phone +390712204421, mail: g.scarpelli@staff.univpm.it

ESTRACTOR

CONSOLIDOMETER

COMPRESSIBILITY TESTING

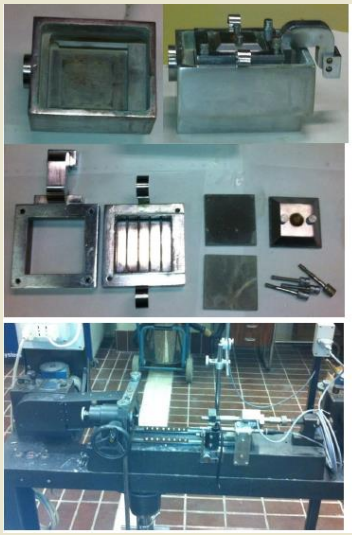
DEPARTMENT OF MATERIALS, ENVIRONMENTAL SCIENCES
AND ENGINEERING AND URBAN PLANNING
Via Brecce Bianche 12, 60131 Ancona (Italy)

AREA: GEOTECHNICAL ENGINEERING

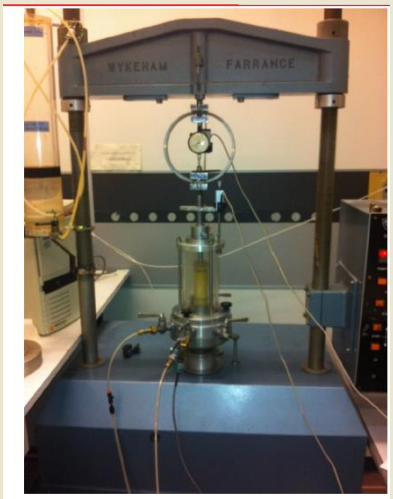
1. SOIL TESTING LABORATORY

Director: PROF. GIUSEPPE SCARPELLI
Phone +390712204421, mail: g.scarpelli@univpm.it

DIRECT SHEAR TESTING



TRIAXIAL TESTING







DEPARTMENT OF MATERIALS, ENVIRONMENTAL SCIENCES
AND ENGINEERING AND URBAN PLANNING
Via Brecce Bianche 12, 60131 Ancona (Italy)

AREA: GEOTECHNICAL ENGINEERING

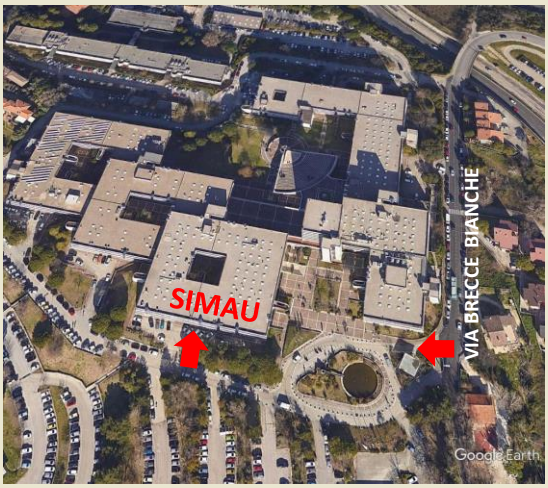
2. ENVIROMENTAL TESTING LABORATORY

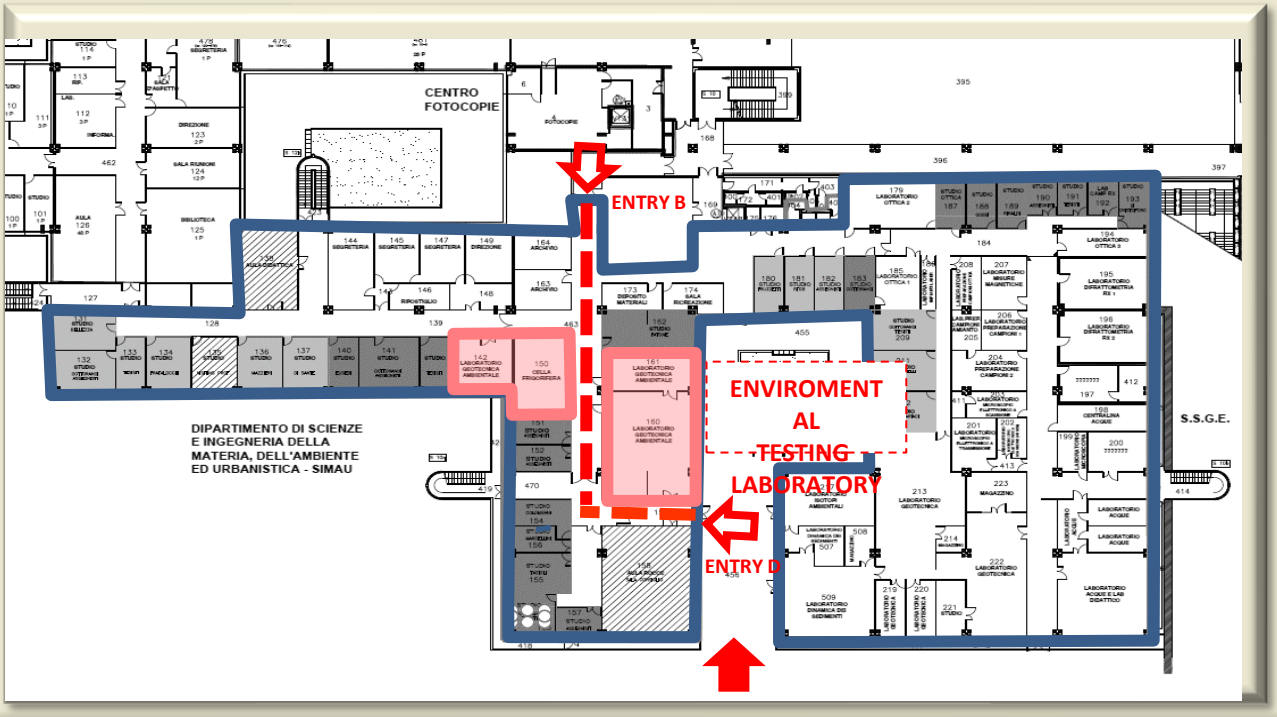
Director: PROF. EVELINA FRATALOCCHI
Phone +390712204793, mail: e.fratalocchi@staff.univpm.it

LOCATION: POLO BELLUSCHI
ELEVATION: 155 meters above sea level
ROOMS: 160, 161, 150, 142

Short description:
The laboratory is able to provide advanced testing for soils, amended soils and mixtures. The following tests are available: Permeability tests (rigid and flexible wall permeameters), chemical compatibility tests (bladder accumulators), oedometric and swelling tests. A new section of the laboratory has recently been equipped with apparatus allowing:

- chemico-osmotic diffusion testing (tracers and solutes)
- evaluation of structural modification of the soil skeleton occurring with amended soils or in the case of reactive solutes(Triaxial cell, BE)





DEPARTMENT OF MATERIALS, ENVIRONMENTAL SCIENCES
AND ENGINEERING AND URBAN PLANNING
Via Brecce Bianche 12, 60131 Ancona (Italy)

AREA: GEOTECHNICAL ENGINEERING

2. ENVIROMENTAL TESTING LABORATORY

Director: PROF. EVELINA FRATALOCCHI
Phone +390712204793, mail: e.fratalocchi@staff.univpm.it

Equipment and testing facilities available:

- 9 incremental loading oeodometer apparatuses
- 16 pressure controls panels for permeability testing
- 28 flexible wall permeameters
- 1 swellling pressure apparatus
- 1 consolidometer-type pemeameter
- 2 rigid-wall permeameters
- 16 bladder accumulator pairs for permeability testing with liquids different than water (assessment of compatibility and migration parameters)

Flexible-wall permeameter equipped with bladder accumulator for the assessment of permeabillity and chemical compatibility of porous media (soils, soil-binder mixtures, cement-bentonite mixtures, geosynthetic clay liners.

DEPARTMENT OF MATERIALS, ENVIRONMENTAL SCIENCES
AND ENGINEERING AND URBAN PLANNING
Via Brecce Bianche 12, 60131 Ancona (Italy)

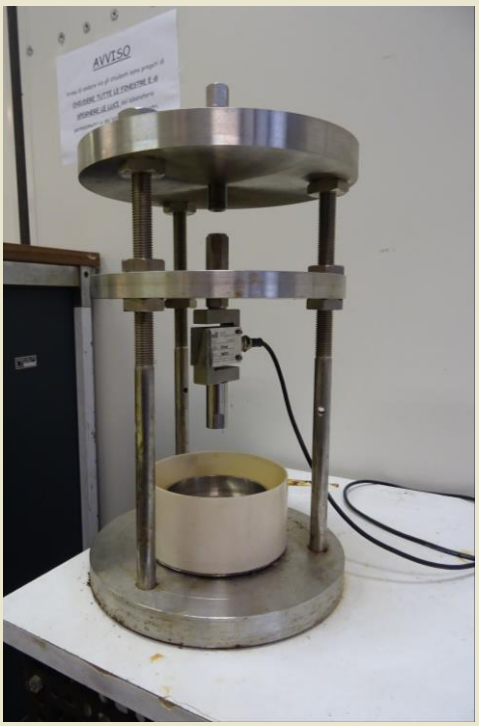
AREA: GEOTECHNICAL ENGINEERING

2. ENVIROMENTAL TESTING LABORATORY

Director: PROF. EVELINA FRATALOCCHI
Phone +390712204793, mail: e.fratalocchi@staff.univpm.it

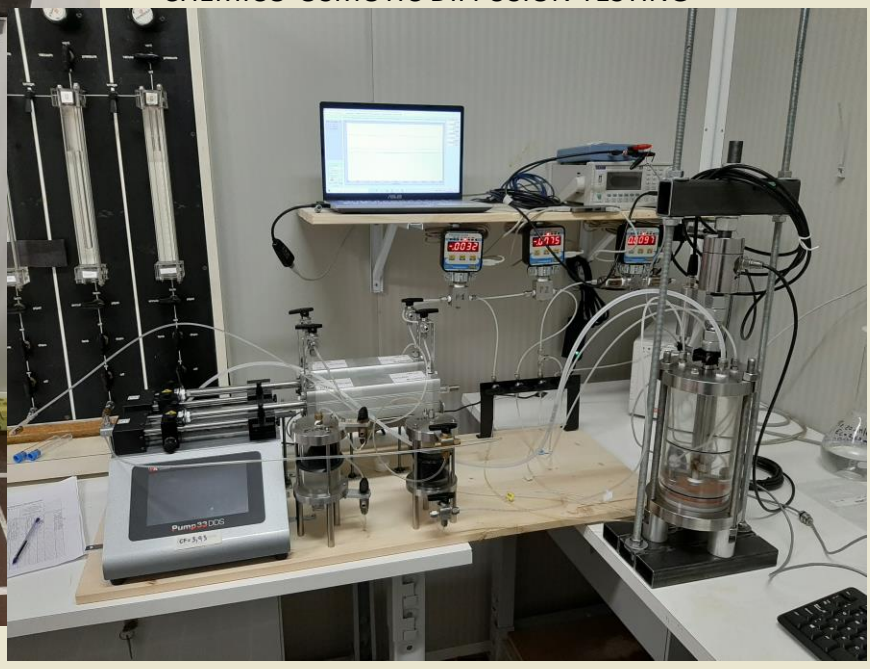
PERMEABILITY AND CHEMICAL COMPATIBILITY TEST

SWELLING TEST



TRIAXIAL CELL

CHEMICO-OSMOTIC DIFFUSION TESTING



Cooperations & Sinergies

Research Centres

- Politecnico di Torino (IT)
- Politecnico di Bari (IT)
- University of Basilicata (IT)
- University of Trento (IT)
- University of Perugia (IT)
- University Federico II , Napoli (IT)
- Università degli Studi della Campania (IT)
- University of Camerino (IT)
- Università di Salerno (IT)
- Università di Perugia (IT)
- Università Roma La Sapienza (IT)
- Università di Cassino (IT)
- Università di Pisa (IT)
- Università degli Studi di Padova (IT)
- University of Graz (A)
- Tampere University (FI)
- Università di Ghent (BE)

Associations

- **AGI, Italian Geotechnical Society**
- **ISSMGE, International Society of Soil Mechanics and Geotechnical Engineering**
- **IGS, International Geosynthetics Society**
- **CEN TC250/SC7**
- **UNI**

Companies

The Company was founded in 1964 by Prof. M. Jamiolkowski as one of the first Italian geotechnical engineering consulting offices. Over the years Studio Geotecnico Italiano has carried out more than 9.000 assignments world-wide, acquiring a recognized international experience and reputation, as well as a large soil engineering database.

ISPRA- SNPA is the The Italian Institute for Environmental Protection and Research, founded (as APAT) in 1999. Contaminated sites management is one of the research topics of the national agency.

The **GES s.r.l.** was born like an Accademic Spin-off of the Università Politecnica delle Marche.
It is a geotechnical engineering consulting company active on the market since 2011.