

POLITECNICO DI MILANO



PhD School of the Politecnico di Milano
Regulations of the Ph.D. Programme in
Structural, Seismic and Geotechnical Engineering
Cycle XXX

Location: Milano Leonardo

1. General Information

Ph.D. School of Politecnico di Milano

Ph.D. Programme: Structural, Seismic and Geotechnical Engineering

Location of the Ph.D. Programme: Milano Leonardo

Subjects (SSD):
ICAR/07 – Soil Mechanics
ICAR/08 – Structural Mechanics
ICAR/09 – Structural Design

Ph.D. School Website: <http://www.polimi.it/phd>

Ph.D. Programme Website: <http://www.dica.polimi.it/dottorato/dot-stru>

Ph.D. Programme BeeP Channel “Dica-Ph.D.”: <https://beep.metid.polimi.it/> (registration in AUnica https://aunicalogin.polimi.it/aunicalogin/aunicalogin/controller/IdentificazioneUnica.do?evn_scelta_lingua=evento&lang=EN&screenName=/IdentificazioneUnica&jaf_currentWFID=main is required to access)

2. General presentation of the Ph.D. Programme

Structural, Seismic and Geotechnical Engineering - SSGE - consists of the traditionally deeply-rooted disciplines and techniques that – in the field of the Civil Engineering – allow to understand, model and control the behavior of structural materials, soils, buildings and the interaction between outdoor environment and construction. It is a highly inter-disciplinary field: the theoretical and applied study of materials and buildings goes along with the analysis of the environmental solicitations, either ensuing from action of natural or anthropical actions, and their interaction with the structure. Because of their generality in materials and structural modeling, the methods developed within the domain of SSGE are also very useful in other technical-scientific domains, whenever understanding and controlling mechanical aspects are necessary to guarantee both design reliability and structural safety, serviceability and durability.

3. Objectives

Within the context outlined above, the primary objective of this Ph.D. programme is to improve the advancement of knowledge, with reference to: (a) innovation in materials and structures; (b) building and product safety under exceptional static or dynamic solicitations or against the deterioration due to the structure life-cycle; (c) soil and surface/buried structure stability.

This objective is pursued by giving Ph.D. candidates advanced, research-oriented training, based on the pivotal role of Structural Engineering and on the multi-disciplinary nature of Seismic and Geotechnical Engineering. More specifically, the 3-year curriculum of the Ph.D. programme in Structural, Seismic and Geotechnical Engineering has the objective of providing the following professional skills that will be developed to a greater or lesser extent according to the specific interests of the candidate:

- (a) Basic and operative knowledge of the main, up-to-date methods used in computational mechanics, in order to model and analyze the elastic, inelastic and cyclic behavior of materials, structures and soil.
- (b) Critical understanding and conscious use of numerical codes, depending on the level of the analysis (micro-, meso- and macro-structural levels).

- (c) Basic and operative knowledge of experimental mechanics, including the most up-to-date experimental techniques and their instrumentation, in order to test materials, structures and soil, either in a laboratory or on site.
- (d) Knowledge of the most common procedures for test-based identification of the parameters characterizing the mechanical properties of materials, soils, and structural damage (for assessment of structural safety).
- (e) Basic and operative knowledge of the design criteria and socio-economic implications governing any major structural project.

4. Professional opportunities and job market

The high-level education promised by the Ph.D. programme in Structural, Seismic and Geotechnical Engineering allows Ph.D.s to continue their activity along three paths: (a) in the academic field; (b) within other public or private research institutions or companies with an outstanding trend for research and development; (c) professional activities (typically as an independent self-employed professional or high-level consultant, mainly in the field of advanced structural design and monitoring - Civil and Environmental Engineering and Industrial Engineering). The inter-disciplinary approach of the Ph.D. programme allows to adopt the gained experience in very different spheres: from the design of great infrastructures to the preservation and restoration of the monumental and architectural heritage, from seismic design to slope stability, not to mention many issues in common with several branches of Industrial Engineering (mechanical, aerospace, nuclear and bioengineering).

5. Enrolment at the Ph.D. Programme

5.1 Admission requirements

Italian and foreign citizens can apply. They are requested to have graduated in accordance with the pre-existing laws D.M. 3.11.1999 n. 509 or they to have a master of science degree in accordance with D.M. 3.11.1999 n. 509 or a master of science in accordance with D.M. 22.10.2004 n. 270 or similar academic title obtained abroad, equivalent for duration and content to the Italian title and for an overall duration of university studies of at least five years.

The certified knowledge of the English language is a requirement for admission. Please refer to the Ph.D. School web site for details.

The admission to the programmes will be decided according to the evaluation of the curricula of the studies, the motivation letter and according to an illustrative paper about the development of a possible Ph.D. research, which candidates will send contextually with their application to the admission announcement.

5.2 Admission deadlines and number of vacancies

The number of vacancies is indicated in the Call for admission to the 30th Cycle of Ph.D. Programmes: <http://www.polimi.it/phd>.

Scholarships both on general and on specific themes are available, in accordance with what is specified in the call for admission.

6. Contents of Ph.D. Programme

6.1 Requirements for the attainment of the title

The attainment of the Ph.D. title in Structural, Seismic and Geotechnical Engineering requires a study and research activity of at least three years equivalent to full time study, research and development of Ph.D. thesis.

The PhD in Structural, Seismic and Geotechnical Engineering foresees at least 35 credits from Ph.D. level courses to be acquired as indicated in the following paragraph 6.3. Additionally, candidates are required to attend seminar activities organized by the Department, according to the rules defined by the Academic Board

6.2 Development of the research and of the Ph.D. thesis

The aim of the Ph.D. programmes of Politecnico di Milano is the development in the candidates of a research-oriented mind-set, with expertise and skills in a specific research topic.

To develop a research-oriented mind-set, the candidates have to acquire the capability of problem-solving in complex context, included a deep analysis of the problem, the identification of an original solution and the capability of evaluating a solution and its applicability in given contexts.

These skills provide the Ph.D. candidates with major opportunities of development in their research both in the academic field and in public and private organisations.

The main objective is the development of an original research contribution. The Ph.D. thesis has to contribute to increase the knowledge in the research field of the candidate. Besides, it has to be coherent with the research topics developed in the department, in which the Ph.D. programme chosen by the candidate, is carried out.

The original research has to be submitted through a Ph.D. thesis which contains and discusses the contribution, even in the field of the state of the art in the research community about the research issue.

The Ph.D. research will be developed according to the guideline of a supervisor, who supports the candidate in the setting-out and in the everyday activities regarding the development of the thesis.

The supervisor does not have to be a member of the Professors Board and can also belong to an institution different from Politecnico di Milano. The supervisor can be supported by one or more co-supervisors.

To develop the capability of carrying out research activities, the candidate will have to attend the courses according to the Ph.D. programme, defined for his/her study plan and pass them with a positive evaluation.

For each candidate admitted to the programme, a tutor, belonging to the Board of Professors, is appointed. The tutor supervises and supports the candidate him/her-self in the overall training path. The supervisor and the tutor can coincide. The choice of the courses will be overseen by the tutor, and it will be formalized in a study plan and approved by the Coordinator of the Ph.D. Programme.

Other activities for the development of own personal skill and research expertise are encouraged during the Ph.D. path.

The candidate has to acquire the capability to present and discuss his/her work in his/her research community. Consequently both the participation to international conferences and publication of the research results in international magazines with review are encouraged.

The candidates are also encouraged to carry out part of their research activities in contact with other research groups in their interest field, preferably abroad.

Research visits of at least three months are strongly encouraged at research groups through which the candidate can acquire further skills to develop his/her research work and the thesis. The duration of the programme is normally three years.

6.3 Objectives and general framework of the teaching activities

The Ph.D. Programmes and the Ph.D. School can activate teaching forms of various kind and of different value (courses, seminars, project workshops, laboratories). All the activities will aim at:

- creating the starting knowledge common to the Ph.D. programme
- examining the basic research issues (problems, theories, research methods) which represent the founding element of the Ph.D. programme and which clearly identify its cultural position;
- deepening in a specialist way some research issues connected with the problems developed in the thesis

Lessons are usually in English language, except when indicated otherwise.

At least one path thoroughly in English language is foreseen in the Ph.D. Programme.

Some teaching activities provide with the rights to acquire ECTS credits (structured teaching activities); other activities, typically specialised and for which it is difficult to evaluate the learning and its quantification, fall within the scientific activities taken into account by the Board of Professors take in the overall evaluation; their value is not quantified in ECTS.

EDUCATIONAL STRUCTURE

The Ph.D. programme in Structural, Seismic and Geotechnical Engineering boasts a group of professors continuously working on the educational aspects of the programme, in order to ensure every year a wide selection of courses for the Ph.D. students, covering all the research areas involved in the programme.

EVALUATIONS

After attending a course, Ph.D. students are requested to pass an exam, whose form (oral, written test or written essay) will be defined within the end of the course by the professor holding the course itself.

Evaluations follow the following grade:

A (corresponding to 30 with Lode and 30)

B (corresponding to 29, 28)

C (corresponding to 27, 26, 25)

D (corresponding to 24 or less, until 18)

E (insufficient)

COURSE PROGRAMMES

Information about course programmes (contents and calendar) can be retrieved on one of these three media:

Politecnico On-Line Services:

https://aunicalogin.polimi.it/aunicalogin/aunicalogin.jsp?id_servizio=376&profile=0&lang=EN&_pj0=0&_pj1=d61e045b2ec12080abad31210e0fbd22 (registration in AUnica is required to access)

Ph.D. Programme Website: <http://www.dica.polimi.it/dottorato/dot-stru>

Ph.D. Programme BeeP Channel “Dica-Ph.D.”: <https://beep.metid.polimi.it/> (registration in AUnica is required to access)

The tables here below show the foreseen path for the candidates and they refer only to coursework activities. At the same time, the programme foresees that the candidate is devoted to the research activity in a continuous way, following the lead of his/her supervisor and of the Board of Professor.

First/Second Year (proposal structure to be tailored)

Courses	Possible details or reference to following tables	Number of credits (min-max)	Notes
Ph.D. School Courses	TABLE A	At least 5	Approval of the tutor prior attending is required
Characterising Courses from the Ph.D. programme in Structural, Seismic and Geotechnical Engineering	TABLE B	At least 30	At least 20 of these 30 credits are required to access the second year. Approval of the tutor prior selection of course is required
Other Ph.D. courses	Courses from other Ph.D. programmes held at Politecnico or other universities, such as CISM and Rose School Courses		Approval of the tutor prior selection of course is required

Third year

In the third year the candidate should be devoted entirely to the research and to the development of the Ph.D. thesis.

PH.D. COURSES

A) CHARACTERISING COURSES ORGANIZED BY THE PH.D. PROGRAMME IN STRUCTURAL, SEISMIC AND GEOTECHNICAL ENGINEERING (TABLE A)

The Ph.D. Programme in Structural, Seismic and Geotechnical Engineering organises the following **characterising Courses** (see Table A)

For the admission to the final exam the acquisition of **at least 30 credits** is **mandatory**. These credits have to be acquired through the “characterising” Ph.D. courses offered by the Ph.D. Programme in Structural, Seismic and Geotechnical Engineering.

During the first year, the acquisition of at least 20 credits is mandatory to be admitted to the second year of the Ph.D. programme.

B) GENERAL AND INTERDOCTORAL COURSES ORGANIZED BY THE PH.D. SCHOOL

The Ph.D. School organises every year general and interdoctoral courses and courses with foreign professors. The acquisition of **at least 5 credits is mandatory** among the courses from Table B or from other courses of the PhD School.

The list of the Ph.D. courses organized by the Ph.D. School is available at the following page: <http://www.dottorato.polimi.it/en/during-your-phd/phd-school-courses/>

C) OTHER PH.D. COURSES

The 30 mandatory credits can be obtained choosing among the Ph.D. course from Table A or Table B, or among other courses provided by other Ph.D. programmes of Politecnico and/or external entities, such as CISM (www.cism.it) or Rose School (www.roseschool.it).

Please remember that the previous approval of the tutor is always mandatory.

D) PREPARATORY COURSES

If the supervisor and the tutor find useful or necessary that the candidate attends preparatory courses (chosen among the activated courses at the Politecnico di Milano) the Board of Professors of the Ph.D. programme can assign some extra-credits to be acquired to complete the training path. The **credits acquired in this way will be considered in addition to the 35 mandatory credits** to be acquired with the Ph.D. level courses.

E) SPECIALISTIC COURSES, LONG-TRAINING SEMINARS

The attendance of specialistic courses, workshops, winter or summer schools, seminars cycles is strongly encouraged and (if these seminars, workshops and so on are certified and evaluated) may permit to acquire credits according the modalities established by the Board of Professors.

For these activities and for the acquisition of credits, prior approval of the study plan by the tutor is mandatory.

These courses and workshops can be inserted in the study plan, even if they are not evaluated (and therefore not qualified as credits), as optional “additional teaching”.

To guarantee a sufficiently broad overview of the scientific activities and results in the research areas of interest to the Ph.D. programme, **each year the candidate is required to attend seminar activities organized within the Department**. Specifically, 70% of the seminars suggested to the PhD candidates, or, alternatively, a minimum of 12 seminars per year, must be attended.

The scheduled plannings of the courses for the academic year 2014-2015 are reported below.

Other courses may be activated during the year; in this case, candidates will be promptly informed.

The candidates will be able to insert these new courses in their study plan.

TABLE A: PH.D. COURSES CHARACTERISING THE PH.D. PROGRAMME IN STRUCTURAL, SEISMIC AND GEOTECHNICAL ENGINEERING

Area	SSD	Title of the Course	Professor(s)	Semester	Credits
General	ICAR/08	Non-linear solid mechanics	Anna Pandolfi	First Semester	5
General	ICAR/08	Non-linear finite element methods in solid mechanics	Attilio Frangi	First Semester	5

General	ICAR/09 ING- IND/12	Experimental methods in material and structural mechanics	Roberto Felicetti, Alfredo Cigada	Spring 2015	5
Structural	ICAR/08	Damage mechanics	Claudia Comi	Jan-Feb 2015	5
Structural	ICAR/09	Multiscale modeling of discrete (particle/lattice) systems for the simulation of heterogeneous quasi-brittle materials	Gianluca Cusatis	To be defined	5
Seismic	ICAR/09	Elastic wave propagation	Roberto Paolucci	January 2015	5
Geotechnical	ICAR/07	Constitutive modelling of geomaterials	Claudio di Prisco	July 2015	5

NOTES:

- All courses will be held in English
- Ph.D. students have to take: at least 2 (two) exams from the General Area;
at least 1 (one) exam from the Structural Area;
at least 1 (one) exam from either the Seismic or the Geotechnical area
- Even though the course entitled “Non-linear solid mechanics” is organized by the Ph.D. School, it can be chosen only to cover part of the 30 mandatory credits from the Table A (and not to cover the 5 credits that must be acquired from the Table B).

TABLE B: SUGGESTED CROSS –SECTORAL COURSES ORGANIZED BY THE PH.D. SCHOOL

Title of the course	Professor(s)	Semester	Language	Credits
Physical methods for cultural heritage	Gianluca Valentini Austin Nevin		English	5
Environmental risks: linking analytical models to prevention decision and operational practice in the field	Scira Menoni, Enrico De Angelis, Francesco Ballio, Alberto Guadagnini		English	5
Building performance based design – Heat and moisture transport modelling applications in building envelope design	Enrico De Angelis		English	5
Course of sheltering: temporary architecture, lightweight construction, textile technology [TEAL-S]	Alessandra Zanelli		English	5
Stochastic inverse problems in environmental sciences	Alberto Guadagnini		English	5

Computational fracture mechanics and cohesive models for damage/degradation	Wolfgang Brocks		English	5
Multi-body systems – Part II	Pierangelo Masarati, Federico Cheli		English	5
Parallel computing using MPI and OpenMP	Luca Breveglieri		English	5
Research Management	Tulio Tolio		English	5

6.4 Presentation of the study plan

Each Ph.D. candidate will have to submit his/her study plan. The candidate will have the opportunity to review it periodically (every three months) in order to adequate it to every possible change of the training offer or to needs motivated by the development of his/her study plan. The study plan is approved by the Coordinator of the PhD programme, according to the modalities established by the Board of Professors of the Ph.D. programme itself.

6.5 Instructions for the annual exams

Every year the candidate is evaluated to be admitted to the next year.

In the annual exam of the third year the admission of the candidate to the final exam (held by an external Commission) is evaluated. The candidate presents his/her work to the Board of Professors at least once a year. A written report of the activities carried out during the year and some slides to support the oral presentation to the Board of Professors are required at the end of every year. After every annual evaluation, the candidate will receive an evaluation (A/B/C/D) or, in case the candidate does not pass the exam, he/she will be qualified “Repeating candidate”(Er) or “not able to carry on with the Ph.D. (Ei)”.

The last year, the candidate who has achieved sufficient results, but needs more time to draw up his/her thesis, can obtain a prorogation of 6 or 12 months, depending on the evaluation of the Teaching Board.

6.6 Other foreseen reviews

No further reviews are foreseen.

6.7 Instruction for the preparation of the Ph.D. thesis

The Ph.D. study and research work will be carried out, full time, during the three years of the Ph.D. course. The possibility of stages or study periods in Italian or in foreign companies or external entities and universities is foreseen.

The main objective is the development of an original research contribution.

The Ph.D. thesis has to contribute to increase the knowledge in the research field of the candidate.

Besides, the thesis has to be coherent with the research issues developed in the department in which the Ph.D. programme, chosen by the candidate, is developed.

The candidate has to present his/her original thesis, discussing its contribution to the state of the art in the research field within the research community.

The Ph.D. research will be developed following the lead of a supervisor, who supports the candidate in the setting out and in the everyday activities regarding the thesis development.

At the end of the studies, the candidate’s admission to the final exam will be evaluated by the Board

of Professors. Afterwards the candidate will have to pass a final exam for the awarding of the title, in which the research work carried out and the thesis will be evaluated by an examination Committee composed by three members, of which at least two external evaluation members.

7. Laboratories, Ph.D. Secretary Services

7.1 Experimental facilities

Experimental research activities related to the Ph.D. programme are supported by various laboratories devoted to structures, materials and geotechnics.

These laboratories are installed in various Politecnico buildings and halls, mainly on Leonardo Campus, namely: (1) a building with a strong floor for testing entire structures under static/dynamic/fatigue loads (steel and concrete structures); (2) a building with 3 presses (a hydraulic, force-controlled press for testing ropes and cables, capacity 500 tons; a hydraulic, fully-controlled press with a capacity of 200 tons and an electromechanical, fully-controlled press with a capacity of 100 tons); (3) a wing with a variety of presses for traditional tests on concrete and with one fully-controlled, electromechanical press with a capacity of 10 tons, for testing concrete and quasi-brittle materials in tension/compression; (4) a wing containing the geotechnical laboratory; (5) a wing containing the masonry and brick-structure laboratory; (6) a hall containing a furnace for heating concrete and concrete elements up to 1000°C (the tests are performed after a thermal cycle) and a split-type furnace for simultaneous heating and loading of specimens; (7) a 600 m² hall for testing anchor bars with hydraulic actuators from 2.5 to 1000 kN, installed on frames with variable inclination. A biaxial traction device is also installed, with 15 electro-mechanical 25 kN actuators in controlled conditions.

Finally, experimental equipment is also available on the Lecco campus, mainly devoted to investigation of advanced cementitious composites. In particular the following devices are available: (a) set-up for workability measures (b) shrinkage test equipments (c) Hydraulic machines (250, 300 and 3000kN max load) and a universal electromechanical machine (max load 30kN) for mechanical characterization (d) furnace able to reach 1200°C (e) climatic chamber ranging between -40°C and 180°C for freezing and thawing. A specific lab for elements under shock loads is equipped with a shock tube generating a wave with a maximum reflected pressure of 2.5MPa and a velocity of 3Mach. Soil structure interaction and fire-blast interaction can also be investigated with this equipment.

7.2 Computational resources

All Ph.D. students will have a personal computer for their exclusive use.

For high performance computing applications, two clusters for parallel computing are currently available in the Department. It is also worth mentioning that Politecnico di Milano is partner of the consortium CINECA (www.cineca.it), which hosts FERMI, ranked 9th among the most powerful supercomputers in the world.

7.3 Ph.D. Student Secretary Service

Emanuela Zonca

Department of Civil and Environmental Engineering

Tel: +39 0223994322

Mobile: +39 331 6000165

Fax: +39 0223994300

e-mail: emanuela.zonca@polimi.it – Skype: emanuela.zonca.polimi

8. Internationalisation and other activities

The carrying out of study and research activities at other laboratories is strongly recommended.

The university proposes also the opportunity of Ph.D. joint paths with foreign universities and of joint and double Ph.D. programmes. Further information are available on the Ph.D. School website and on the Ph.D. programme website.

Attachment A1 – Ph.D. Board of Professors – Collegio dei Docenti

The Ph.D. programme in Structural, Seismic and Geotechnical Engineering boasts a Board of Professors consisting of faculties belonging to the Department of Civil and Environmental Engineering, thus ensuring a continuous assistance and supervision to the Ph.D. students.

Name	Affiliation	SSD / Title of SSD
Roberto Paolucci (Coordinator)	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/09 - Structural Design
Ardito Raffaele	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural Mechanics
Biondini Fabio	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/09 - Structural Design
Bolzon Gabriella	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural Mechanics
Comi Claudia	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural Mechanics
Corigliano Alberto	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural Mechanics
Coronelli Dario	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/09 - Structural Design
Di Prisco Claudio	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/07 – Soil Mechanics
Di Prisco Marco	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/09 - Structural Design
Felicetti Roberto	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/09 - Structural Design
Ferrara Liberato	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/09 - Structural Design
Frangi Attilio Alberto	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural Mechanics
Garavaglia Elsa	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural Mechanics
Jommi Cristina	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/07 – Soil Mechanics

Malerba Pier Giorgio	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/09 - Structural Design
Mariani Stefano	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural Mechanics
Perego Umberto	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural Mechanics
Perotti Federico	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural Mechanics
Petrini Lorenza Maria	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural Mechanics
Zanzi Luigi	Politecnico di Milano - Department of Civil and Environmental Engineering	GEO/11 – Applied Geophysics

Attachment A2 – Ph.D. Advisory Board

The Ph.D. Advisory Board is composed by managers and high-level self-employed people working in companies where research and development play a role of leading importance. Their knowledge of the market trends, their advices and their experience are of great help when outlining new educational paths within the Ph.D. programme.

Name	Affiliation
Albert Luigi	Soil Geotecnica, Milano
Anelli Ettore	Tenaris, Dalmine
Beltrami Carlo	Lombardi-Reico Ingegneria, Milano
Borsari Roberto	Tetra Pak. Packaging Solutions S.p.A.
Canetta Giovanni	CeAS, Milano
Cangiano Stefano	C.T.G. Italcementi, Bergamo
Gabetta Giovanna	ENI, Milano
Mazzà Guido	Enel-RSE
Negro Paolo	JRC, Ispra
Scuri Silvia	Artech srl, Milano
Teora Maurizio	Arup Italia
Zambon Massimo	Techint, Milano