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Ph.D. School - Politecnico di Milano
Regulations of the Ph.D. Programme in:
Structural, Seismic and Geotechnical Engineering

Cycle XXXII

Location: Milano Leonardo

1. General Information

Ph.D. School - 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/en/dottorato**

2. General presentation

Structural, Seismic and Geotechnical Engineering - SSGE - encompasses the disciplines and techniques that – traditionally deeply-rooted in the field of Civil Engineering, but with important industrial applications as well – 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 anthropic 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 in the framework of the research activities carried out at the Department of Civil and Environmental Engineering of Politecnico di Milano (see for reference the presentation available here. For this purpose, Ph.D. candidates are given 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 architectonical 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

5.1 Admission requirements

Italian and international citizens can apply. They are requested to have graduated in accordance with the pre-existing laws D.M. 3.11.1999 n. 509, or 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, with 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 PhD. School website for details.
The admission to the programmes will be established according to the evaluation of the candidates' curricula, motivation letters, and an illustrative report 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 32th Ph.D. cycle 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

6.1 Requirements for the Ph.D. title achievement

The achievement of the Ph.D. title in Structural, Seismic and Geotechnical Engineering requires a study and research activity of at least three years equivalent of full time study, research and development of Ph.D. thesis.
The PhD in Structural, Seismic and Geotechnical Engineering requires at least 35 credits from Ph.D. level courses, to be earned as described in paragraph 6.3 below.
Additionally, candidates are required to attend seminar activities organized by the Department, according to the rules defined by the Academic Board.

6.2 Research development

The main aim of all Ph.D. programmes at 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 this end, candidates develop a problem-solving capability in complex contexts, including the capacity of performing deep problem analysis, identifying original solutions, and evaluating their applicability in practical 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.
Ph.D. candidates are requested to develop an original research contribution. The Ph.D. thesis must thus contribute to increase the knowledge in the candidate's research field. Besides, it has to be coherent with the research topics developed in the Department where the Ph.D. Programme is carried out.
The original research results are collected in the Ph.D. thesis, where the candidate's contribution is put in perspective with respect to the research state of the art in the specific research field.
The Ph.D. research is developed under the guidance of a supervisor, who supports the candidate in the setting-out and in the everyday activities related to the thesis development. The supervisor is not

necessarily a member of the Board of Professors, and may 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, candidates must earn a minimum of 35 credits (from courses coherent with their Ph.D. programme. To each candidate admitted to the programme, a tutor, belonging to the Board of Professors, is appointed. The supervisor and the tutor may coincide.
The tutors supervise and support the candidates over all their training path. They assist the candidates in the choice of courses to be included in a study plan, which must finally be approved by the Coordinator of the Ph.D. Programme.
Further activities intended to develop the candidate's personal skills and research expertise are encouraged during the Ph.D. path.
Candidates must acquire the capability to present and discuss their work in their research community. Consequently, both the participation to international conferences and the publication of the research results in peer-reviewed journals are encouraged.
The Ph.D. Programme favors the candidates' research interactions with other groups in their research field, preferably abroad. Research visits of at least three months are strongly encouraged, as through them the candidates may acquire further skills to develop their research work and 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 activate teaching forms of different kind and credit value, including courses, seminars, project workshops, laboratories. Teaching activities both cover the basic research issues (problems, theories, methods), which represent the founding element of the Ph.D. Programme and identify clearly its cultural position, and deepening in a specialist way some research issues connected with the problems developed in the theses.
Lessons are usually held in English, except when indicated otherwise. The Ph.D. programme includes at least one complete path delivered in English language.
Structured teaching activities allow to earn ECTS credits. Other activities, typically specialised and for which it is difficult to evaluate the learning and its quantification, fall within the scientific activities of which the Board of Professors takes into account in the overall evaluation, but they do not allow to earn ECTS.

DIDACTIC 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 30/30 cum Laude and 30/30)
B (corresponding to 29/30, 28/30)
C (corresponding to 27 to 25/30)
D (corresponding to 24/30 or less, down to 18/30)
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://www11.ceda.polimi.it/manifestidott/manifestidott/controller/Main.do (registration in AUnica is required to access)

Ph.D. Programme Website:

http://www.dica.polimi.it/en/dottorato/phd-course-in-structural-seismic-and-geotechnical-engineering/teaching-activities

The tables below summarize the candidate's activity plan (as regards courseworks). At the same time, the programme foresees that the candidates are continuously devoted to research activity, following the lead of their supervisors, and of the Board of Professors.

First/Second Year

Courses	*Possible details or reference to following tables*	*Number of credits (min-max)*	*Note*
PhD School Courses	TABLE B	At least 5	Approval of the tutor prior attending is mandatory
Courses characterising the Ph.D. Programme	TABLE A	At least 30	At least 20 credits (earned from Table A and/or Table B) 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. Course List

A) The Ph.D. Programme in Structural, Seismic and Geotechnical Engineering organises the **Characterising Courses** listed in Table A.

For the admission to the final exam the acquisition of at least 30 credits in this list is **mandatory**.

During the first year, the acquisition of at least 20 credits from Table A or 15 credits from Table A+5credits from Table B is mandatory to be admitted to the second year of the Ph.D. programme.

B) The Ph.D. School organises every year general and interdoctoral courses. The acquisition of **at least 5 credits** is **mandatory** among the courses from the Table B The list of Ph.D. courses organized by the Ph.D. School is available at the website http://www.dottorato.polimi.it/en/during-your-phd/phd-school-courses

C) Other Ph.D. courses

Example: a maximum of XXX mandatory credits can be obtained by choosing among courses provided by other PhD programmes at Politecnico di Milano and/or external Institutions (in this case the previous approval of the tutor and the coordinator is mandatory).

In alternative to those listed in Table A, some of the 30 mandatory credits can be obtained by choosing either among the Ph.D. courses provided by other Ph.D. programmes of Politecnico and/or by external institutions, such as CISM (www.cism.it) or Rose School (www.roseschool.it). In this case, prior approval by the tutor and by the Coordinator is mandatory.

PREPARATORY COURSES (only if foreseen)

If the supervisor and the tutor find it 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 may assign some extra-credits to be acquired to complete the training path. The credits acquired in this way will be considered as additional, in relation to the mandatory credits to be acquired with the Ph.D. courses.

SPECIALISTIC COURSES, LONG-TRAINING SEMINARS

The attendance of specialist courses, workshops, schools, seminars cycles is strongly encouraged and (if these seminars, workshops are certified and evaluated) may permit to acquire credits according the modalities established by the Board of Professors and previous approval of the study plan submitted by the candidate. 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 course planning for the academic year 2016-2017 follows. Other courses may be activated during the year. In this case the candidates will be promptly informed, and will be allowed to insert these new courses in their study plan.

Table A: PH.D. COURSES CHARACTERISING THE PH.D. PROGRAMME

SSD	Name of the Course	Professor	A.Y./Semester	Language	Credits	Area
ICAR/08	Damage mechanics	Prof. Claudia Comi	A.Y. 2016-2017	English	5	Structural
ICAR/09	Summer School 2017: Fibre Reinforced Concrete (FRC) – Material characterization and structure design	Prof. Marco di Prisco	A.Y. 2016-2017 Second semester (July 2017)	English	5	Structural
ICAR/08	Stochastic differential equations for structural engineering	Prof. Claudio Floris	A.Y. 2016-2017 First semester	Englis	5	Seismic
ICAR/08	Non-linear finite element methods in solid mechanics	Prof. Attilio Frangi	A.Y. 2016-2017	English	5	General
ICAR/09	Elastic wave propagation with applications to earthquake engineering	Prof. Roberto Paolucci	A.Y. 2016-2017	English	5	Seismic
ICAR/08	Non linear solid mechanics	Proff. Anna Pandolfi, Maurizio Vianello, Siro Casolo	A.Y. 2016-2017	English	5	General
ICAR/09	Experimental methods in material and structural mechanics	Proff. Roberto Felicetti, Alfredo Cigada	A.Y. 2016-2017	English	5	General
ICAR/07	Constitutive modelling of geomaterials	Prof. Claudio di Prisco	A.Y. 2016-2017	English	5	Geotechnical
Other characterizing courses activated during the A.Y. 2016-17 or during the following Academic Years.						

Table B SUGGESTED CROSS –SECTORAL COURSES

Please check Table B at this web address: http://www.dottorato.polimi.it/en/during-your-phd/phd-school-courses

NOTES:

- All courses in Table A 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
- The previous requirement does not apply to Ph.D. students enjoying external funding, such as from industry (e.g., "borse a tema") or from research projects (e.g., "assegni di ricerca"). For them, only the requirement of 2 exams from the General Area applies, while the further doctoral courses can be selected in the area more closely related to their research topic.
- The courses appearing in both Tables A and B can be chosen by the Ph.D. student either to comply with the 30 credits requirement for characterizing courses or with the 5 credits for General and Interdoctoral courses.

6.4 Presentation of the study plan

Ph.D. candidates must submit a study plan, which may be revised periodically (approximately every three months), in order to adequate them to possible changes in the course list, or to needs motivated by the development of their Ph.D. career. The study plans must be approved by the Ph.D. programme Coordinator, according to the modalities established by the Board of Professors of the Ph.D. Programme itself.

6.5 Yearly evaluations

Candidates present their work to the Board of Professors at least once a year. In particular, the candidates must pass an annual evaluation in order to be admitted to the following Ph.D. year.

The third year evaluation establishes the candidate's admission to the final Ph.D. defense. As a result of each successful annual evaluation, the candidates receive an evaluation (A/B/C/D). Candidates who do not pass the exam will be qualified as "Repeating candidate"(Er) or "not able to carry on with the Ph.D. (Ei)".

After the final year, candidates who have achieved sufficient results but need more time to draw up their theses, may obtain a prorogation of up to 12 months.

Candidates will be provided guidelines to prepare their presentations for the yearly evaluations and for the admission to the final exam.

6.6 Ph.D. thesis preparation

The main objective of the Ph.D. career is the development of an original research contribute. The Ph.D. thesis is expected to contribute to the advance of the knowledge in the candidate's research field.

The Ph.D. study and research work is carried out, full time, during the three years of the Ph.D. course. Stages or study periods in (Italian or international) companies or external Institutions may complete the candidate's preparation.
The resulting theses need to be coherent with the research issues developed in the Department where the Ph.D. programme is developed.
The candidate must present an original thesis, discuss its contribution to the state of the art in the research field in the research community.
The Ph.D. research is 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 conclusion of the PhD studies, the Board of Professors evaluates the candidates. Candidates who receive a positive evaluation submit their theses to two external reviewers for refereeing. If the evaluation provided by the reviewers is positive (o after the revisions required by the external reviewers), the candidates defend their thesis in a final exam, in front of a Committee composed of three members (at least two of which must be external experts).

7. Laboratories, Ph.D. Secretary Services

7.1 Experimental facilities

Advanced experimental research activities related to structures, materials and geotechnics are mostly supported by the Testing Lab for Materials, Buildings and Civil Structures (see web site http://www.lpm.polimi.it/), which is an officially accredited Lab for testing structures and structural elements with forces ranging from 0.01 to 5000 kN, as well as to carry out physical/mechanical tests on structural and geomaterials, both in ambient and in high-temperature conditions. An experimental facility is also available on the Lecco campus, mainly devoted to investigation of impact loads and advanced cementitious composites.
PhD students are strongly encouraged to practice experimental activities, both by organization of visits at the lab and by the yearly organization of courses on Experimental Structural Mechanics.

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

8. Internationalisation and other activities

Carrying out study and research activities at external laboratories is strongly recommended.

Politecnico di Milano supports joint Ph.D. paths with international Institutions, as well as 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

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
Bamonte Patrick	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/09 - Structural Design
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
Bruggi Matteo	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural Mechanics
Comi Claudia (Vice-Coordinator)	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
Della Vecchia Gabriele	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/07 – Soil Mechanics
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 -	ICAR/09 - Structural

	Department of Civil and Environmental Engineering	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
Ghisi Aldo	Politecnico di Milano - Department of Civil and Environmental Engineering	ICAR/08 – Structural 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
Martinelli Luca	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
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
Beltrami Carlo	Lombardi 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