University of Brescia

Doctoral Program in *Natural Risk Assessment and Management*

Beginning of the courses: November 2010

Program duration: 3 years

1 - Disciplines Involved in the Program - Italian code (SSD) and name

SSD	Name
ICAR/01	Hydraulics
ICAR/02	Maritime Hydraulic Construction and Hydrology
ICAR/07	Geotechnical engineering
ICAR/08	Mechanics of materials and structures
ICAR/09	Structural engineering
ICAR/20	Urban and Land Planning
GEO/05	Applied Geology
MAT/05	Mathematical Analysis
MAT/08	Numerical Analysis
MAT/09	Operational Research
SECS-P/06	Applied Economics
SECS-S/06	Mathematics for Economics, Actuarial Studies and Finance

Interdisciplinary Themes: Civil Engineering, Environmental and Land Engineering, Economics, Geology.

2 – Centers of the Doctoral Program

Administrative Center: University of Brescia. Department of Civil Engineering, Architecture, Land and Environment (DICATA)

Other Departments of the University of Brescia involved in the programme: Department of Quantiative Methods; Department of Mathematics.

International Centers: The University of Brescia is member of IH2CU - the Honors Center of Italian Universities for International Education (www.h2cu.com); in this framework, and not only, collaboration agreements have been stipulated with Pace University of New York (NY), Columbia University of NY, University of NY-Polytechnic Institute, Massachusetts Institute of Technology (MIT), Water Resources University of Hanoi (Vietnam) and CEMAGREF (France)).

3 – Doctoral Board

1) **Baldassare Bacchi**, **PhD Coordinator,** Full Professor, University of Brescia, Department of Civil Engineering, Architecture, Land and Environment (DICATA), SSD ICAR/02-Maritime Hydraulic Construction and Hydrology

CURRICULUM VITÆ ET STUDIORUM

Family name : **BACCHI**
Surname : **Baldassare**
Born in S. Ninfa(TP) 25-04-1952 (April, 25, 1952)

Office address:
Department of Civil Engineering, Architecture, Land and Environment – DICATA
Via Branze, 43 – 25123 BRESCIA - I
Tel. +390303711280 (office), +393208558782(mobile),
+390303711213 (secretary), Fax +393711312

Education

1971	Classical Lyceum bac. at the 'Villa Sora' College –Frascati (Rome)
1972-1977	Degree (*cum laude*) in Civil Engineering at 'Ghislieri College' - University of Pavia, October 24, 1977

Appointments

1978-1981	CNR fellow in Water Engineering at Politecnico di Milano , Italy
1982-1986	Researcher in Water Engineering at Politecnico di Milano, Italy
1987-1990	Associate professor of Hydrology at Politecnico di Milano, Italy
1991-*present*	Full professor of Hydraulic Structures and Hydrology at the University of Brescia, Italy

Research fields

Water resources estimate and management, Hydrology of floods (peaks and volumes), Floods mitigation methods, Stochastic Hydrology applied to water resources (monthly runoff) and extreme events (floods and heavy rainfalls), Urban Hydrology, Hydraulic works design and planning, Flood forecasting through hydrological conceptual models, Soil erosion and transport, Spatially distributed rainfall-runoff models.

Official teaching activities

2005-*present*	Applied Hydraulics for Edile-Architettura five years course of degree, at the University of Brescia, Italy
2007-2009	Hydraulic Infrastructures for Edile-Architettura five years course of degree, at the University of Brescia, Italy
2007-*present*	Hydraulic Structures for Building Engineering, two years course for Master degree, at the University of Bergamo, Italy
1991-2004	Hydraulic Structures for Civil and Environmental Engineering, at the University of Brescia, Italy
1987-2000	Hydrology course for Environmental Engineering, at Politecnico di Milano, Italy
1978-1987	Different teaching supports with seminars, lectures, exercise, tutoring and examination to the courses of Hydraulics, Hydrology, Hydraulic Structures

Some special teaching activities and invited lectures

PhD Thesis	tutoring or co-Tutoring of PhD's Thesis of: 1)A. Brath, 2)Xie Mei, 3)P. Burlando, 4)D. Adom, 5)G. Becciu, 6)R. Ranzi, 7)*L. Falappi*, 8)*S. Barontini*, 9)*M. Balistrocchi*
1979-1989	Lectures cycles on Dynamic Hydrology, Stochastic Hydrology, Hydro-meteorological networks at the Master Course "Hydrology and Water Resources Management" – Politecnico di Milano, supported by IILA for Latino-American students, Italy
1988	Short course (30 h) on "Dynamic Hydrology" at the FCTH – University of S. Paulo, Brazil
1980-2000	Invited lectures at Long-term education program of Politecnico di Milano at courses of Urban Hydrology, Water resources management, Risk assessment for urban areas, etc.

Selected management activities

1982-1990	Member of Civil Engineering council for teaching activities, Politecnico di Milano, Italy
1987-1990	Member of Engineering Faculty Council of Politecnico di Milano, Italy
1991-present	Member of Engineering Faculty Council of University of Brescia, Italy
1991-1993	Reporter of Engineering Faculty Council of University of Brescia, Italy
1996-2002	Chair of the Civil Engineering Department of University of Brescia, Italy

1991-present Member of Civil Engineering, Environmental Engineering and Architectural Engineering council for teaching activities, University of Brescia, Italy

2000-present Member of Civil Engineering, Environmental Engineering and Architectural Engineering commission for teaching programming, University of Brescia, Italy

Main Research Projects

2006-2008 Guide-line for the hydraulic network rehabilitation in Franciacorta (BS), COGEME-SpA

2005-2006 Hydrologic balance estimate for the Oglio River, ARPA –Lombardy Region

2005 Flood Damages Mitigation through Satellite Observation Products : LAMPOS, CNR-ISAO through an Italian Space Agency grant, Bologna, Italy

2003-2004 Delimitation of the natural basin in the alluvial valley of the Oglio River, COGEME-SpA

2000-2002 Snow water equivalent estimation from satellite images and ground measurements, ENEL-CRIS, Venice, Italy

1991-2000 CNR-GNDCI coordinator of the RU 1.33 of Brescia University (flood and heavy rainfalls statistical and real-time forecasting)

1998-1999 Provincial Program for Hydrological and Hydraulic Risk Assessment, Provincia di Brescia, Italy

1996-1998 Mathematical Models for Low Flows Estimate, Politecnico di Milano, Italy

1997-1998 Design flood estimate for spillways improve, ENEL-CRIS, Venice, Italy

1994-present Mesoscale Alpine Programme (MAP), envolved in hydrological and hydrometeorological studies (also member of Scientific Committee)

1994-1998 General Coordinator of Runoff and Atmospheric processes for flood HAzards forEcasting and control-RAPHAEL (EU Project-ENV4-CT97-0552)

1999-2000 Brescia Coordinator of MURSTesearch Project: *Climatic and Atrophic Effects on Flood Behaviour*

1995-1998 Brescia Coordinator of MURTS Research Project: *Climate-Hydrology Interactions*

1986-1988 Member of MPI Research Project group on: *Mathematical and Physical Models in Hydrology*

1983-1985 Member of MPI Research Project group on: *Flood Phenomena Analysis*

1979-1982 Water Resources Estimation for Central Calabria Region (Italy), chair Prof. U. Majone

Selected Associations

IAHS – AISH: International Association of Scientific Hydrology
EGU – European Geosciences Union
AGU – American Geophysical Union
AII – Associazione Idrotecnica Italiana
GII – Gruppo Italiano di Idraulica (rappresentante di sede)
CINFAI – Brescia University Coordinator of the RU
SII-IHS – Società Idrologica Italiana – Italian Hydrological Society (Fondatore e tesoriere)

Selected papers

Journals

BACCHI B., BALISTROCCHI M, GROSSI G (2009). Sull'efficienza delle vasche di prima pioggia. L'ACQUA, vol. 6, ISSN: 1125-1255

BALISTROCCHI M, GROSSI G, BACCHI B. (2009). An analytical probabilistic model of the quality efficiency of a sewer tank. WATER RESOURCES RESEARCH, ISSN: 0043-1397, doi: 10.1029/2009WR007822

PILOTTI M, TOMIROTTI M, GRASSIA D, BACCHI B. (2009). Formulazione semplificata in forma adimensionale dell'idrogramma conseguente al crollo parziale di uno sbarramento di ritenuta. L'ACQUA, vol. 2; p. 21-36, ISSN: 1125-1255

RANZI R, BACCHI B., CEPPI A, CISLAGHI M, EHRET U, JAUN S, MARX A, HEGG C, ZAPPA M (2009). Real-time demonstration of the hydrological ensemble forecast in MAP D- PHASE. LA HOUILLE BLANCHE, vol. 5; p. 1-10, ISSN: 0018-6368

BACCHI B., BALISTROCCHI M, GROSSI G (2008). Proposal of a semi-probabilistic approach for storage facility design. URBAN WATER JOURNAL, ISSN: 1573-062X

BARONTINI S, RANZI R, BACCHI B. (2007). Water dynamics in a gradually nonhomogeneous soil descibed by the linerized richards equation. WATER RESOURCES RESEARCH, vol. 43, ISSN: 0043-1397, doi: 10.1029/2006WR005126

RANZI R, ZAPPA M, BACCHI B. (2007). Hydrological aspects of the Mesoscale Alpine Programme: findings from field experiments and simulations. QUARTERLY JOURNAL OF THE ROYAL METEOROLOGICAL SOCIETY, vol. 133, Part B, Issue 625; p. 867-880, ISSN: 0035-9009, doi: 10.1002/qj.68

RANZI R., BACCHI B., ZAPPA M (2005). Hydrological aspects of the Mesoscale Alpine Programme: finding from field experiments and simulations. CROATIAN METEOROLOGICAL JOURNAL, vol. 40; p. 134-137, ISSN: 1330-0083

BACCHI B., R. RANZI (2003). Hydrological and meteorological aspects of floods in the Alps: an overview. HYDROLOGY AND EARTH SYSTEM SCIENCES, vol. 7(6); p. 784-798, ISSN: 1027-5606

RANZI R., BACCHI B., GROSSI G. (2003). Runoff measurements and hydrological modelling for the estimation of rainfall volumes in an alpine basin. QUARTERLY JOURNAL OF THE ROYAL METEOROLOGICAL SOCIETY, vol. 129-B; p. 653-672, ISSN: 0035-9009

RANZI R., BOCHICCHIO M., BACCHI B. (2002). Effects on floods of recent afforestation and urbanisation in the Mella River (Italian Alps). HYDROLOGY AND EARTH SYSTEM SCIENCES, vol. 6(2); p. 239-265, ISSN: 1027-5606

ARBELAEZ A.C., BACCHI B., RANZI R., ARANGO H. (2000). Aplicación de la técnica "wavelets" a un campo de precipitaciòn. AVANCES EN RECURSOS HIDRAULICOS, vol. 7; p. 52-61

RANZI R, GROSSI G., BACCHI B. (1999). Ten years of monitoring areal snowpack in the Southern Alps using NOAA-AVHRR imagery, ground measurements and hydrological data. HYDROLOGICAL PROCESSES, vol. 13; p. 2079-2095, ISSN: 0885-6087

BACCHI B., PILOTTI M. (1997). Distributed evaluation of the contribution of soil erosion to the sediment yield from a watershed. EARTH SURFACE PROCESSES AND LANDFORMS, vol. 22; p. 1239-1251, ISSN: 0197-9337

BACCHI B., RANZI R. (1996). On the derivation of the areal reduction of storms. ATMOSPHERIC RESEARCH, vol. 42; p. 123-135, ISSN: 0169-8095

BACCHI B., RANZI R., BORGA M. (1996). Recognition of the statistical character of spatial patterns of rainfall cells. JOURNAL OF GEOPHYSICAL RESEARCH, vol. 101; p. 26277-26286, ISSN: 0148-0227

BACCHI B., KOTTEGODA N.T. (1995). Identification and calibration of spatial correlation patterns of rainfall. JOURNAL OF HYDROLOGY, vol. 165; p. 311-348, ISSN: 0022-1694

BACCHI B., BRATH A., MAIONE U. (1993). Sul dimensionamento delle reti di drenaggio con la metodologia dell'evento critico. IDROTECNICA. L'ACQUA NELL'AGRICOLTURA, NELL'IGIENE E NELL'INDUSTRIA, vol. 1; p. 33-43, ISSN: 0390-6655

BACCHI B., BRATH A., KOTTEGODA N.T. (1992). Analysis of the relationships between flood peaks and flood volumes based on crossing properties of riverflow process. WATER RESOURCES RESEARCH, vol. 28(10); p. 2773-2882, ISSN: 0043-1397

ROSSO R., BACCHI B., LA BARBERA P. (1991). Fractal relation of mainstream length to catchment area in river networks. WATER RESOURCES RESEARCH, vol. 27(3); p. 381-387, ISSN: 0043-1397

BACCHI B., BRATH A. (1990). Stima delle leggi di riduzione delle massime portate in assegnata durata. ENERGIA ELETTRICA, vol. 4; p. 9-22, ISSN: 1590-7651

BACCHI B., LARCAN E., MAIONE U. (1988). Influenza di un serbatoio di regolazione sulla distribuzione di frequenza dei colmi di piena. ENERGIA ELETTRICA, vol. 10; p. 435-446, ISSN: 1590-7651

BACCHI B., MAIONE U. (1984). Influenza di un volume di laminazione sulla distribuzione di probabilità dei colmi di piena. ENERGIA ELETTRICA, vol. 10; p. , pp.399-413, ISSN: 1590-7651

Books contributions

BACCHI B., BALISTROCCHI M, GROSSI G, PAPIRI S, TODESCHINI S (2006). Cap.4: SISTEMI DI FOGNATURA E ACQUE METEORICHE DI DILAVAMENTO. In: BERTANZA G; PAPIRI S. MANUALI DI INGEGNERIA AMBIENTALE. vol. 6, p. 133-192, MILANO: CIPA EDITORE, ISBN/ISSN: ISSN 1126-1129

BARONTINI S., CLERICI A., RANZI R., BACCHI B. (2005). Saturated hydraulic conductivity and water retention relationships for Alpine montain soils. In: DE JONG C.; COLLINS D.N.; RANZI R.. Climate and Hydrology in Mountain Areas. p. 101-122Wiley & Sons, ISBN/ISSN: 0-470-85814-1

BACCHI B., FALAPPI L., GROSSI G., RANZI R. (2000). Measurements and simulations of low flows in Alpine rivers. In: MAIONE U.; MAIONE LETHO B.; MONTI R.. New Trends in water and Environmental Engineering for safety and Life: eco-compatible solutions for acquatic environments. p. 13, ROTTERDAM: A.A.. Balkema, ISBN/ISSN: 90-5809-138-4

PILOTTI M., BACCHI B. (2000). Modelling river quality in an alpine basin: the Valle Camonica case. In: MAIONE U.; MAIONE LETHO B.; MONTI R.. New Trends in water and Environmental Engineering for Safety and Life: eco-compatible solutions for aquatic environments. p. 12, ROTTERDAM: A. A. Balkema, ISBN/ISSN: 90-5809-138-4

BACCHI B. (1997). Un approccio metodologico agli studi idrologici e idraulici per la difesa idraulica dei territori fortemente antropizzati. In: MAIONE U.; BRATH A.. LA DIFESA IDRAULICA DEI TERRITORI FORTEMENTE ANTROPIZZATI . p. 59-89, COSENZA: Editoriale BIOS

RANZI R., BACCHI B. (1994). Analysis and forecasting of rainfall fields observed using radar. In: ROSSO R.; PEANO A.; BECCHI I.; BEMPORAD G.A.. Advances in Distributed Hydrology. p. 327-346, FORT COLLINS (CO.): Water Resources Publications

VILLI V., BACCHI B. (2001). VALUTAZIONE DELLE PIENE NEL TRIVENETO. PERUGIA: Tipolitografia Grifo, vol. 2511, p. 322

BACCHI B. (1996). Le reti pluviometriche. SALERNO: CNR-GNDCI, vol. 1620, p. 98

Conferences Proceedings

BALISTROCCHI M, GROSSI G, BACCHI B. (2008). Assessment of long term efficiency of CSO capture tanks by semiprobabilistic methods. In: 11th Conference on Urban Drainage, August 31 - September 5, EDIMBURG (UK)

BARONTINI S, BELLUARDO G, BACCHI B., RANZI R (2008). Esperimento per la verifica dell'innesco di una falda effimera in un terreno disomogeneo. In: ATTI DEL XXXI CONVEGNO DI IDRAULICA E COSTRUZIONI IDRAULICHE. PERUGIA, 9-12 Settembre, PERUGIA

GROSSI G, BACCHI B., BUZZI A, MALGUZZI P, RANZI R (2008). Reliability analysis of a hydrological ensemble prediction system. In: Variability in time and space of extreme raifalls, floods and droughts. Cosenza, 6-8 June, CASTROLIBERO: Ferrari E. e P. Versace (Eds), p. 121-132, ISBN/ISSN: 978-88-6093-045-3

PILOTTI M, TOMIROTTI M, GRASSIA D, BACCHI B. (2008). Una metodologia speditiva per la caraterizzazione dell'idrogramma conseguente al crollo parziale di uno sbarramento di ritenuta. In:

ATTI DEL XXXI CONVEGNO DI IDRAULICA E COSTRUZIONI IDRAULICHE. PERUGIA, 9-12 Settembre, PERUGIA

BACCHI B., GROSSI G, PENNESI L, POTENZA P, RANZI R (2007). Some experience on flood event simulation and flood scenario definition in the Tevere basin. In: Proceedings. Venice, Italy, 1-6 July, IAHR Pubbl., vol. CD-ROM, p. 10

BACCHI B., GROSSI G, PENNESI L, POTENZA P, RANZI R, SCHIAVONI A (2007). Flood simulation and estimation in the Tevere river: a deterministic and probabilistic approach. In: Observing and modelling exceptional flood and rainfalls, Ferrari E. e P. Versace (Eds). COSENZA, 3-4 May 2006, CASTROLIBERO (CS): Nuova Editoriale Bios, p. 183-199, ISBN/ISSN: 978-88-6093-024-8

BACCHI B., BALISTROCCHI M, GROSSI G (2007). Un approccio semiprobabilistico alla progettazione di vasche a servizio delle reti di drenaggio urbano. In: FREGA G.. Tecniche di difesa dell'inquinamento 27° edizione. , COSENZA: Nuova Editoriale Bios

BACCHI B., GROSSI G, RANZI R, BUZZI A (2007). Il contributo della modellistica matematica alla difesa dalle piene. In: Le alluvioni in Italia. Roma, 7-8 Maggio 2007, ROMA: La Sintesi, vol. CD-ROM, p. 197-209

BALISTROCCHI M, GROSSI G, BACCHI B. (2007). Analisi dei criteri di gestione delle vasche di prima pioggia mediante metodi innovativi. In: II° Convegno di idraulica urbana: Acqua e Città. Chia (CA), 25-28 Settembre, MILANO: Centro Studi Idraulica Urbana, ISBN/ISSN: 978-88-900282-7-4

BARONTINI S, BACCHI B., RANZI R (2007). Water dynamics in a gradually non-homogeneous soils. In: CD-ROM. BRESCIA, 11-14 SettembreCasa Editrice Starrylink, ISBN/ISSN: 978-88-89720-69-1

GROSSI G, BACCHI B., BUIZZA R, BUZZI A, MALGUZZI P, RANZI R (2007). Hydrological ensemble prediction systems: the 1966 'century' flood experiment. In: 3th HEPEX Workshop. ISPRA (VB)-Italy, 27-29 June, ISPRA (VB): JRC-ISPRA

BARONTINI S, RANZI R, BACCHI B. (2006). An analytical solution of the Richards' equation for a gradually nonhomogeneous soil. In: XXX Convegno di Idraulica e Costruzioni idrauliche. Roma, 11-16 settembre 2006, ROMA: Università la Sapienza, ISBN/ISSN: 978-88-87242-81-2

GROSSI G, BACCHI B., BUIZZA R, BUZZI A, MALGUZZI P, RANZI R (2006). Toward the MAP D-PHASE experiment of a Hydrological Ensembre Prediction System. In: Proceedings. Vienna, 6-8 November, WIEN: Universitaet Wien, p. 40-43

RANZI R, GALEATI G, BACCHI B. (2006). Idrogrammi di piena di progetto dedotti dalla trasformazione afflussi-deflussi. In: XXX Convegno di Idraulica e Costruzioni idrauliche. Roma, 11-16 settembre 2006, ROMA: Università la Sapienza, ISBN/ISSN: 978-88-87242-81-2

BACCHI B., BALISTROCCHI M, GROSSI G, RANZI R (2005). Progetto di invasi a servizio di reti di drenaggio urbano: un approccio basato sul concetto di rischio. In: Atti del I° Convegno di idraulica urbana: Acqua e Città, 27-30 Settembre, SANT'AGNELLO: Centro Studi Idraulica Urbana (CD-ROM), ISBN/ISSN: 88-900282-4-6

BACCHI B., BOCHICCHIO M, TOMIROTTI M, VILLI V (2004). Applicazione del metodo dell'area di influenza per la stima delle portate di piena dei corsi d'acqua dell'Italia settentrionale. In: XXIX Convegno di Idraulica e Costruzioni Idrauliche, 7-10 Settembre 2004, vol. Vol. II, p. 5-12, ISBN/ISSN: ISBN 88-7740-382-9

BACCHI B., GROSSI G., RANZI R., BUZZI A. (2004). Experiences on the use of coupled mesoscale meteorological and hydrological models for flood forecasting. In: Hydrological Risk: recent advances in peak river flow modelling, predict. and real-time forecasting, 24-25 Ottobre 2003, Bologna, p. 219-230, ISBN/ISSN: ISBN 88-77403780

TASCHNER S, RANZI, R, BACCHI B., GALEATI G (2004). Monitoring the snow water equivalent in the Piave headwater applying a remotely sensed based approach. In: IGARSS-IEEE. ANCHORAGE-ALASKA, 20-24 September 2004, vol. Vol. VI, p. 2692-2695, ISBN/ISSN: ISBN CD-ROM 0-470-85814-1

RANZI R., BACCHI B., GROSSI G. (2003). Hydrological runoff data and modelling for the estimation of areal rainfall volumes a an alpine basin. In: International Conference on Alpine Metorolology and MAP-Meeting, 19-23 May 2003, vol. Vol. B, p. 304-307, ISBN/ISSN: ISSN1422-1381

BACCHI B., GROSSI G., RANZI R. (2002). Un metodo semiprobabilistico per il dimensionamento di una vasca di laminazione. In: XXVIII Convegno di Idraulica e Costruzioni Idrauliche, Potenza, vol. 4, p. 339-348

BACCHI B., GROSSI G., RANZI R., BUZZI A. (2002). On the use of coupled mesoscale meteorological and hydrological models for flood forecasting in midsize mountain catchments: operational experience and verification. In: International Simposium on Flood Defence, Beijing, China, September 10-13, vol. II, p. 965-972, ISBN/ISSN: 1-880732-54-0

RANZI R., BACCHI B., GROSSI G., BUZZI A., MALGUZZI P., RATTO C., CORAZZA M. (2000). Previsioni di piena mediante un modello idrologico e un modello meteorologico ad area limitata: alcune esperienze applicative durante l'esperimento MAP-SOP. In: XXVII Convegno di Idraulica e Costruzioni Idrauliche, vol. II, p. 385-392

RANZI R., BACCHI B. (1998). Il bilancio idrologico nelle aree montane per la stima delle disponibilità idriche: alcuni problemi aperti. In: XXVI Convegno di Idraulica e Costruzioni Idrauliche, vol. III, p. 347-358

BACCHI B., BRATH A., MAIONE U., ROSSO R. (1990). Analisi regionale delle leggi di riduzione delle massime portate in assegnata durata. In: XXII Convegno di Idraulica e Costruzioni Idrauliche, vol. 3, p. 157-168

BACCHI B., ROSSO R., LA BARBERA P. (1987). Storm characterization by Poisson models of temporal rainfall. In: XXII IAHR Conference, vol. 4, p. 35-40

BACCHI B., RANZI R., RICHARD E. (a cura di) (2003). Hydrometeorological process and floods in the Alps. di: AUTORI VARI. - KATLENBURG-LINDAU: European Geophysical Union vol. 7(6), p. 783-950, ISBN: 1027-5606

History of Hydrology

BACCHI B. (2008). Bernardino Zendrini, Matematico della Repubblica, Camuno di nascita, Veneto honoris causa. X SAVII SOPRA LE X, vol. 5; p. 4-11

BACCHI B. (2007). Idrologia padana all'epoca della commissione Brioschi. In: FERRARI I.; PELLEGRINI M.. Un Po di carte. p. 109-124, REGGIO EMILIA: Edizioni Diabasis, ISBN/ISSN: 978-88-8103-109-2

BACCHI B., ORLANDINI S, PELLEGRINI M (2007). Le alluvioni del Po nel XIX secolo: alla ricerca delle cause. In: FERRARI I.; PELLEGRINI M.. Un Po di carte. p. 145-165, REGGIO EMILIA: Edizioni Diabasis, ISBN/ISSN: 978-88-8103-109-2

H-index: 9 (in June 2010)

2) **Rosella Levaggi,** Full Professor**,** PhD, University of Brescia, Department of Economic Sciences, SSD SECS-P/03-Finance

3) **Prof. Oscar Jose Mesa Sanchez**, Department of Geosciences and Environmental Sciences. Universidad Nacional de Colombia at Medellín (UNALMED).

4) **Angelo Carini,** Full Professor, University of Brescia, Department of Civil Engineering, Architecture, Land and Environment (DICATA), SSD ICAR/08- Construction Science

5) **Maurizio Tira,** Full Professor, University of Brescia, Department of Civil Engineering, Architecture, Land and Environment (DICATA), SSD ICAR/20-Urban and Land Planning

6) **Roberto Ranzi,** Full Professor, PhD, University of Brescia, Department of Civil Engineering, Architecture, Land and Environment (DICATA), SSD ICAR/02-Maritime Hydraulic Construction and Hydrology

7) **Magalì E. Zuanon,** Associate Professor, University of Brescia, Department of Quantitative Methods, SSD SECS-S/06-Mathematics for Economics, Actuarial Studies and Finance.

8) **Marco Pilotti,** Associate Professor, PhD, University of Brescia, Department of Civil Engineering, Architecture, Land and Environment (DICATA), SSD ICAR/01-Hydraulics

9) **Alberto Clerici,** Associate Professor, University of Brescia, Department of Civil Engineering, Architecture, Land and Environment (DICATA), SSD GEO/05-Applied Geology

10) **Massimo Tomirotti,** Associate Professor, PhD, University of Brescia, Department of Civil Engineering, Architecture, Land and Environment (DICATA), SSD ICAR/02-Maritime Hydraulic Construction and Hydrology

11) **Alessandra Marini,** Assistant Professor, PhD, University of Brescia, Department of Civil Engineering, Architecture, Land and Environment (DICATA), SSD ICAR/09-Construction Techniques

4 – Teaching programme

The PhD Program is structured into the following different profiles (curricula):

A. Curriculum "Risk Assessment"

A.1. sub-curriculum "Hydraulic and Hydrological Risk Assessment and Management"

A.1. sub-curriculum "Seismic Risk Assessment and Management"

B. Curriculum "*Risk Management under Natural Hazards "*.

The teaching programme includes monographic courses, cycles of seminars and courses held by internal and external lecturers and laboratory work. These activities are aimed at giving a basic preparation for highly qualified research activities.

The topic of the PhD thesis and the Tutor must be determined before the end of the first year, in agreement with the Doctoral Board.

In order to obtain the Ph.D title the candidate must earn 180 credits distributed as follows:

- **50 credits** reserved for the attendance of *basic courses* offered by the PhD Program or by other PhD programmes in the framework of co-operation agreements with Italian or foreign universities (subject to the approval of the PhD Board); a typical 5 credits course of the PhD programme is based on 10 hours lectures, 40 individual study hours and on a final examination (or, alternatively, on a written report or personal exercises). 10 credits courses are based on 20 hours lectures. The number of credits corresponding to different course schedules will be determined by the Doctoral Board, proportionally to the teaching charge. Part of the above 50 credits (up to 30) can be granted after attending to

seminars organised within this or other Doctoral programmes, once approved by the Tutor and the Doctoral Board.

-**50 credits** reserved for the attendance of *advanced courses*, specific for each curriculum. These credits should be earned preferably during the second year.

- **80 credits** reserved for the *research activity* on the specific topic of the Ph.D dissertation.

Each PhD student is expected to spend a period of at least 3 months abroad in a foreign research center; this period shall not exceed 18 months in all. The corresponding location will be agreed upon by the PhD student, the tutor and the PhD coordinator.

The PhD Programme involves the following educational activities:

a) basic courses (up to a maximum of 60 credits). It is also possible to earn credits by attending courses offered in the degree programmes of the University of Brescia (subject to the approval of the Doctoral Board).

b) advanced courses (specifically intended for PhD students), for a minimum of 40 credits, which allow the PhD students to specialize in some research areas;

c) attendance of seminars and specialization courses; the corresponding credits are assigned by the Doctoral Board;

d) teaching experience, consisting of seminar activities or teaching assistance in the framework of exercise or laboratory sessions of undergraduate courses designated by the Doctoral Board;

e) training activities in the framework of agreements with research centers or industries; the credits that can eventually be earned in this way are assigned by the Doctoral Board.

Each PhD student is requested to earn at least 100 credits for activities a) and b).

Basic courses

COURSES	HOURS	CREDITS
Advanced mathematical methods	30	15
Numerical methods	20	10
Statistical methods in engineering	20	5
Risk Analysis and Evaluation	20	5
Environmental economics	30(1)	10
Financial and Actuarial Mathematics	20	10
Managing Risk with Catastrophe Modeling	10	5

Aadvanced courses

A.1.Curriculum *Risk Assessment* – sub-curriculum "*Hydraulic and Hydrological Risk Assessment and Management*"

COURSES	HOURS	CREDITS
Environmental Fluid Mechanics (*)	20	5
Geomechanics of land-slide (*)	20	5
Sediment Transport (*)	20	5
Floods and droughts (*)	20	5
Stochastic processes (*)	20	5
Shallow water equations (*)	20	5
Free courses and seminars (see below)		10

(*) mandatory courses

A.2. Curriculum *Risk Assessment* – sub-curriculum "*Seismic Risk Assessment and Management*

COURSES	HOURS	CREDITS
Fundamentals of seismology(*)	20	5
Mechanical and numerical problems in seismology (*)	20	5
Geomechanics of landslides (*)	20	5
Advanced structural dynamics (*)	20	5
Stochastic processes (*)	20	5
Seismic strengthening of existing buildings (*)	20	5
Free courses and seminars (see below)		10

(*) mandatory courses

B. Curriculum *Risk Management under Natural Hazards*

COURSES	HOURS	CREDITS
Fundamentals of seismology(*)	20	5
Geomechanics of landslides (*)	20	5
Management and planning in hazardous areas (*)	20	5
Emergency planning (*)	20	5
Stochastic processes (*)	20	5
Economic evaluation of commons (*)	20	5
Free courses and seminars (see below)		10

(*) mandatory courses

free courses

COURSES	HOURS	CREDITS
Operations research	20	10
Transport in porous media	20	5
Snow avalanches and debris-flow	10	5
Land slide mathematical models	20	5

Structures for land slide remediation	20	5
Advanced stochastic processes	10	5
Courses and seminars in others doctoral schools or courses whit the agreement of the Tutor end of the PhD Coordinator		
Courses of a different sub-curriculum		
Courses organized each year by the Teaching staff in collaboration with others Italians or Foreign Universities		
Stages at research institutions or in qualified professional ateliers or factories		

5 - Courses/Syllabi

The Doctoral Programme in **Natural Risks Assessment and Management**, is framed within a long-term expertise developed at the University of Brescia in different fields, within research projects funded by the European Commission, the Ministry of University and Research, the Ministry of Foreign Affairs and other public and private funding agencies.

The Course aims at developing an advanced background in both risk assessment, environmental impact assessment and risk management from an economic point of view. It is 'Glocal'-oriented, i.e. it pays attention both to global-scale scenarios of natural hazards and is also applied to regional-scale problems.

The main scientific areas involved in the courses of the Doctoral Program are:

ICAR/01-Hydraulics, ICAR/02-Maritime Hydraulic Construction and Hydrology; ICAR/07-Geotechnics; ICAR/08-Construction Science; ICAR/09-Construction Techniques; ICAR/20-Urban Planning; SECS-P/03-Finance; SECS-P/06-Applied Economics; SECS-S/06-Mathematics for Economics, Actuarial Studies and Finance; MAT/05-Mathematical Analysis; MAT/08-Numerical Analysis; MAT/09-Operational Research; GEO/05-Applied Geology.

All the above disciplines play a significant role in the overall educational project. The contents of both basic and advanced courses are summarized in the next sections.

5.1 – Basic courses

Advanced mathematical methods (30 hours):

1. Functions series: point and uniform convergence; total convergence; derivation and integration by using series expansion.

2. Trigonometric series. Fourier series: definitions, calculus, mean square convergence. Convergence criteria for uniform and point convergence. Derivation of the ourier series.
3. Functions of a complex variable: derivation. Definitions and properties of the holomorphic functions. Taylor series. Isolated singularities; Laurent series; residue theorem. Application to the computation of real integrals.
4. Fourier Transforms in L^1 and in L^2; Plancherel's theorem. Transforms properties. Applications.
5. Laplace transform of a function. Transforms properties. Applications.

Numerical methods (20 hours):

1. Numerical solution of large linear systems. Krylov methods. Preconditioning.
2. Finite difference methods for the discretization of ordinary differential equations. Stability and convergence analysis.
3. Weak formulation of elliptic and parabolic differential equations. Galerkin approximation. Time discretization of parabolic equations by finite difference methods: stability and convergence analysis

Statistical methods in engineering (20 hours):

Probability: definitions and axioms; main theorems on conditional probability and total probability; Bayes theorem. Main probability distribution functions utilised in engineering problems and relationship between moments and parameters: discrete and continuous variables. Random variables and samples; samples moments estimate; plotting positions. Estimate of a statistical parameter: moments method, maximum likelihood, least squares, p.w.m. Testing statistical hypothesis; inference of a PDF. Multivariate analysis: regression and correlation; multivariate distributions. Order statistics. Return Period. PDF's of extremes. Example of application extracted from Hydrological, Seismic, Geo-technical engineering. (suggested book: Kottegoda N.T. & Rosso R., Applied statistic for civil and environmental engineers, Blackwell Publishing, 2008)

Risk Analysis and Evaluation (20 hours):

Land and natural resources. Development limits and environmental sustainability.
Land as a complex system: definitions of risk, hazard, vulnerability and exposition regarding urban and land planning and their components.
Risk perception: socially acceptable risk and risk mitigation policies. Comparison among different risk phenomena. The human component of risk.
Land and environment sociology.
International legislation about natural disasters.

Financial and Actuarial Mathematics (20 hours):

1. Introduction
   1.1. Basics of Financial Calculus
2. Stochastic discounting
   2.1. Basic discrete time model
   2.2. Valuation al time t>0
   2.3. Technical and financial variables
3. Valuation Portfolio in life insurance
   3.1. Deterministic life insurance model
   3.2. General valuation procedure for deterministic technical risks
4. Financial risks
   4.1. Procedure to control financial risks
   4.2. Financial modeling

References

1. Buhlmann H., H. Furrer, M.V. Wuthrich, Market-consistent Actuarial Valuation, Springer, 2008
2. Duffie D., Dynamic Asset Pricing Theory, Princeton University Press, 1996
3. Lamberton D., B., Lapeyre, Introduction au calcul stochastique appliqué à la finance, SMAI n.9, Ellipses Editions, 1991

Managing Risk with Catastrophe Modeling (10 hours):

1. Framework for Risk Management using catastrophe Models
   1.1. Needs and government initiatives
   1.2. Catastrophe models and Insurance
2. Natural Hazard Risk assessment Process
   2.1. Natural Hazards
   2.2. Impact of uncertainties on catastrophe modeling
3. Linking Risk Assessment with Insurance
   3.1. Use of catastrophe models in insurance rate making
   3.2. Insurance protfolio management

References

1. Buhlmann H., H. Furrer, M.V. Wuthrich, Market-consistent Actuarial Valuation, Springer, 2008
2. Grossi P., H. Kunreuther, Catastrophe modeling, springer, 2005
3. McNeil A., R. Frey, P. Embrechts, Quantitative risk management, Princeton University Press, 2008

Environmental economics (20 hours):

Environmental economics applies standard microeconomic analysis to the field of the natural environment. This course aims to provide students with a sound knowledge and understanding of the major basic results of environmental economics. The course examines the measurement of environmental and natural resource values. Fundamental

questions will be addressed. Does economic growth imply environmental destruction? What are optimal levels of pollution control and energy conservation? What policy options exist for achieving these goals?
Part-1
Economics and the Environment. The production system. Economic system from linear to circular economy. The economic characteristics of environmental goods. Environment & Ethics. Economic growth and the environment. Market, public intervention and the environment. Economic efficient level of pollution. Pigouvian taxes and subsidies. Regulatory instruments. Effects of environmental taxes. Road pricing and other alternatives. Alternative energy sources. The value of the environment. Effectiveness of economic instruments for environmental policy. Environmental resources such as natural resources. Renewable resources. Non-renewable resources. Common resources and their management. Water resources management.
Part-2
The valuation of environmental resources. Evaluation of environmental goods. Methods to elicit preferences. Time, decisions and the environment. Environmental economics intertemporal decisions. Sustainable development. Tourism, Environment and Sustainable Development. The economic evaluation of historic architectural property. Global environmental problems and international agreements.
Part-3
In depth study of a specific theme chosen by the students from those proposed by the teacher (e.g. sustainable tourism certification, waste management).

Texbooks
Tietenberg T. Economia dell'ambiente, McGraw-Hill, 2006
Musu I., Introduzione all'economia dell'ambiente, Il Mulino, Bologna, 2003
In english:
T. Tietenberg (2000) Environmental and Natural Resources Economics, Reading, MA
D. Pearce, K. Turner (1990) Economics of Natural Resources and the Environment

5.2 – Advanced courses

A. Curriculum *Risk Assessment*

A.1-Sub-curriculum *Hydraulic and Hydrological Risk Assessment and Management*

Environmental fluid mechanics (20 hours):

Fundamental Equations. Rate of Strain, Vorticity, and Circulation. Lagrangian and Eulerian Approaches. The Equations of Motion and Constitutive Equations. Conservation of Energy. Inviscid Flows and Potential Flow Theory. Boundary Layers; The Equations of Motion for Boundary Layers; The Integral Approach of Von Karman; Reynolds-averaged equations. Isotropic, homogeneous turbulence; Surface Water Waves; Geophysical Fluid Motions; The Boussinesq approximation. The Coriolis Force. Rotation Effects: Geostrophic Flows and Vorticity Dynamics; Ekman layer; Barotropic Waves. Stratification Effects: Internal Waves; Turbulence in Stratified Fluids.

Geomechanics of landslides (20 hours)

Landslides description: features, geometry, activity, rate of movement, water content. Types of movements in soil and in rock masses: fall, topple, slide, spread, flow, buckling, less frequent types. Material and mass strength characteristics. Processes contributing to cause landslides. Investigation, instrumentation and warning systems. Remedial measures. Landslide hazard evaluation. Landslide risk management.

Sediment transport (20 hours):

Hydraulic Properties of Sediments, Mechanical properties of free surface flows; Dimensionless analysis; Beginning of Sediment Transport; Bed-Load Calculations; Suspended Sediment Calculations; Sand waves; Friction factor in presence of sediment transport; Debris flow: Mechanics, Process of occurrence, development and declination; Characteristics of fully developed flow; Debris Flow Disasters and their Reproduction by Computer Simulations. Countermeasures for Debris Flow Disasters

Floods and droughts (20 hours):

Streamflow generation processes in a watershed. Distributed rainfall-runoff models: terrain representation, stream networks, rainfall-runoff partitioning, meteorological forcing in a distributed model.
Frequency analysis of peak flow data: peak over threshold (POT) and Annual Maxima (AM) series. Extreme value distributions: Gumbel, Fréchet, Weibull distributions, Generalized Extreme Value (GEV) distribution. Two-Component Extreme Value (TCEV) distribution. Other distributions used as extreme value models. Parameter estimation methods. Frequency analysis of flood volumes: Flood Duration Frequency reduction curves. Design flood estimation: at site and regional estimation methods for peak discharges. Design flood hydrograph estimation based on statistical methods: at site and regional estimation methods. Design Flood estimation via rainfall-runoff models. Structural and non-structural flood mitigation measures. Flood control reservoirs. Flood forecasting models.
Flow Duration Curves (FDC); at site and regional estimation of FDC. Low flow characteristics: percentiles of low flows from the FDC. Frequency analysis of minimum flows in different durations. At site and regional estimation of minimum flow quantiles. Drought indicators: Palmer Drought Severity Index (PDSI), Standardized Precipitation Index (SPI). Monitoring and forecasting of droughts. Drought mitigation measures.

Stochastic processes (20 hours):

Stochastic processes in the space-time domain. Realisations of stochastic proceses, ergodicity, probability distribution functions and statistical moments. Covariance and

correlation. Geostatistical methods for random fields estimation and network design. Power spectra of random fields. Random, regular and clustered point processes. 1D and 2D Poisson and Neymann-Scott clustered processes. Fractal measures of random fields. Modelling of space-time precipitation fields. Simulation algorithms for non-Gaussian random fields, simulation of multidimensional binary random fields with application to modeling random media, seismic ground motion, wind forces, ocean waves. Effects of random heterogeneity of soil properties on bearing capacity.

Textbooks:
Vanmarke, Random fields, MIT Press
Cressie, Statistics of spatial data, Wiley.
Cox & Isham, Point processes, Chapman&Hall.
Turcotte, Fractals And Chaos In Geology And Geophysics, Cambridge.

Shallow water equations (20 hours):

The 1D and 2D shallow water equations. Hyperbolic character and eigenstructure of the equations. Characteristic form. Integral form. Conservative and non-conservative forms. Weak solutions and Rankine-Hugoniot jump conditions. Riemann problem. Basics on numerical methods: explicit and implicit schemes; accuracy, consistency, stability and convergence. Conservative methods, finite difference and finite volume methods. First-order methods: upwind and centered methods, the basic schemes of Godunov and Lax-Friedrichs. TVD methods and High Resolution schemes. Numerical treatment of source terms and boundary conditions. Dam-Break modelling: the basic analytical solutions for the 1D case; numerical test cases for 1D and 2D dam break flows; 1D numerical modelling on irregular topographies; basics on 2D numerical modelling.

A.2 Sub-curriculum *Seismic Risk Assessment and Management*

Fundamentals of seismology (20 hours):

Representation of seismic sources. Elastic waves from a point dislocation source. Plane waves in homogeneous media and their reflection and transmission at a plane boundary. Reflection and refraction of spherical waves; Lamb's problem. Surface waves in a vertically heterogeneous medium. Free oscillations of the earth. Body waves in media with depth-dependent properties.

Geomechanics of landslides (20 hours)**:** (see before)

Mechanical and numerical problems in seismology (20 hours):

Principles of seismometry. Analysis of seismological data. Inverse problems in seismology. Kinematics and dynamics of seismic sources. Seismic waves in three-dimensionally inhomogeneous media. Crack-fault initiation and propagation. High-performance

numerical methods for seismic wave propagation in complex 3D geological configurations.

Advanced structural dynamics (20 hours):

Introduction to seismic waves, if not covered by other courses.
Soil-structure interaction analysis: kinematic interaction, inertial interaction, surface foundations, embedded foundations, piles.
Multi-correlated seismic motion: artificial accelerograms.
Simplified fluid-structure interaction.

(*) The course prerequisites are "Structural Dynamics (10 credits), that should be included in the basic doctoral courses, if not already present in the students' curricula.

The course content strongly depends on the contents of the structural dynamics courses offered in the 'Laurea magistrale / Laurea specialistica' curricula; so it can change according to changes in the LM/LS curricula.

Stochastic processes (20 hours): (see before)

Seismic strengthening of existing buildings (20 hours)

Part 1 – Vulnerability assessment of historical masonry and rc buildings
- Analysis of resisting mechanisms
- Evaluation of the lateral load collapse multipliers

Part 2 – Strengthening of masonry:
- Design of floor and roof diaphragms
- Tie confining systems
- Arches and vaults strengthening
- Connections
- Repairing of damaged structures

Part 3 – Strengthening of r.c. buildings:
- Strengthening with walls systems
- Repairing of damaged structures

The course is the same delivered in the existing PhD on "Preservation and Structural Rehabilitation of Historical and Modern Buildings"

B. Curriculum *Risk Management under Natural Hazards*

Fundamentals of seismology (20 hours): (see before)

Geomechanics of landslides (20 hours)**:** (see before)

Management and planning in hazardous areas (20 hours):

Management of seismic micro-zonation and flood and landslide risk zones in Master Plans. Urban planning solutions for risk reduction; link between ordinary planning and emergency planning; urban vulnerability assessment methods.

References:

1. Comfort L., Managing Disasters: strategies and policy perspectives, Duke Press Policy Studies, 1988
2. Cox S. J. ,Tait N.R.S., Reliability, Safety & Risk Management : An Integrated Approach, Butterworth Heinemann, 1991
3. Tira M., Pianificare la città sicura, Edizioni Librerie Dedalo, Roma, 1997
4. Tira M., Tiboni M., Badiani B. and C. Confortini, Urban infrastructures and physical hazards: a *challenge for planning*, Proceedings of the International Conference "Risk Analysis 2006" (Malta 19-21 June 2006)

Emergency planning (20 hours):

The Italian Civil Protection System: laws, activities, responsibilities. The Civil Protection at UE level and short comparison among other Countries' Civil Protection Systems.

Civil Protection Plans in Italy: local natural risks assessment connected to Master Plan; creation of different local scenarios with crisis management and intervention matrix.

References:

1. Aysan Y., Oliver P. , Housing and Culture after Earthquakes – a guide for future policy making on housing in seismic areas, Oxford Polytechnic, 1987
2. Perry R.W., Mushkatel A.H. Disaster management: warning response and community relocation, Quorum Books, 1984
3. Horlick-Jones ,Natural risks and Civil Protection, Taylor & Francis, 1995
4. Tira M., Blancher P., Badiani B. and C. Confortini, Setting a safety policy, in Røstum J., Novembre V. and J. Vatn (eds.) Proactive crisis management of urban infrastructure, Final report of the COST Action C19, SINTEF Byggforsk (N), 2008, ISBN 978-82-536-1003-0, pp. 107-113

Stochastic processes (20 hours): (see before)

Economic evaluation of commons (20 hours):

Economic and political geography. Disaster evaluation as a social and economic loss of the whole country. Prevention and economic resume strategies in ordinary urban and land planning. The value of commons (common natural goods).

References:

1. Brown, L., Flavin, C., and French, Hillary (eds.), State of the World 2001, Worldwatch Institute, W.W. Norton & Company, 2001

2. Munich Re Group, Annual Report 2008, Münchener Rückversicherungs-Gesellschaft, 2009
3. United Nations Development Programme, Skopje resurgent : the story of a United Nations special fund town planning project , United Nations, 1970

NOTE
Besides the courses offered in the PhD Programme, each PhD student is allowed/requested to attend seminars, summer schools and similar, organized either by the University of Brescia or by other research centers and suggested by the Doctoral Board.
During the period abroad, each PhD student can attend courses organized by the host research center; the corresponding credits are assigned by the Doctoral Board.

The admittance of each PhD student to the second year of the doctoral Program is conditional to the achievement of 30 credits at least; the admittance to the third year is conditional to the achievement of 70 credits. In really exceptional and documented cases (to be justified through a specific report by the tutor) the admittance to successive years for PhD students lacking credits can be allowed by the Doctoral Board; however, the missing credits have to be fulfilled within the third year of the Doctoral Program. PhD students lacking credits are not admitted to the final examination; in this case the PhD students are allowed to continue attending the Program without financial support of the Administration.

6 – Mission and goals of the Doctoral Program

The main goals of the Doctoral Program are:

developing professional profiles in the field of hydrology and hydraulics of the extreme events (floods and droughts), with reference both to forecasting tools and economic impact assessment;

developing researcher profiles in the field of structural rehabilitation of buildings in seismic areas;

developing researcher profiles in the field of structural design of buildings in seismic areas;

developing researcher profiles in the field of natural risk assessment and management;

stimulating collaboration activities with public agencies in charge of land protection and planning, with reference to the topics of the Doctoral Program (e.g. hazard mapping, emergency planning, etc.);

stimulating collaboration activities with Italian and foreign Universities aimed to organize seminars and PhD courses to be held by researchers of high international scientific profile;

stimulating collaboration activities with other Italian and foreign Universities aimed to set up and carry on joint research projects in the fields of the Doctoral Program;

promoting PhD students mobility among Italian and foreign research centers, encouraging interdisciplinary attitude and cultural/scientific exchange. To this purpose, the PhD students will be enrolled in the Inter-university Center for International Education (H2CU) exchange programme.

7 - Studentships

a) Minimum number of studentships: 2

b) Number of studentships without financial support of the Administration: 2

c) Surplus studentships without financial support of the Administration (both for Eu and for non-EU citizens): in dependence on the available resources.

8 – Admittance requirements and entrance examination

Requisite for the admittance to the Doctoral Program is the MSc degree ("Laurea Vecchio ordinamento" or " Laurea specialistica / magistrale") obtained from an Italian University, or equivalent academic title obtained from foreign University, in: *Civil Engineering*, *Land and Environmental Engineering*, *Environmental Sciences*, *Geological Sciences, Environmental Economics*.

For foreign candidates, the equivalence of the academic titles is established by the Doctoral Board.

In cases in which the requisites are considered acceptable but not fully sufficient, the candidates can complete the doctoral teaching programme of the first two years attending courses offered in the degree programmes of the University of Brescia (according to the directives of the Doctoral Board).

Admittance applications of candidates that have not completed the degree programme can be conditionally accepted, provided that the degree certificate is presented by the candidates within the date of the entrance examination.

Admittance requirements to the studentships with and without financial support (a) and (b)

An entrance examination must be passed. The entrance examination consists of: 1)a written test; 2)an oral test. The oral test concerns also the knowledge of one or more foreign languages (according to the announcement of competition).

The examination board can assign a maximum of 60 scores for each test. The minimum score required to pass each test is 40. In case of equality of the overall score, the candidate with higher degree score is selected. In case of further equality, the younger candidate is selected.

Foreign candidates can request the Board to held the entrance examination in English.

Admittance requirements to the surplus studentships for non-EU citizens (c)

Admission to the Doctoral Program will be determined on the basis of an assessment of the educational CV, a cover letter and the proposal for doctoral research projects which the applicants must send at the time of the admittance application. Designated members of the Doctoral Board will interview in tele-conference the candidates (e.g. via Skype) for the final decision on their admittance.

Brescia, June 2010