



**AGREEMENT OF COOPERATION  
FOR THE GRANTING OF A DOUBLE MASTER DEGREE  
IN REHABILITATION OF HISTORIC BUILDINGS**

**Between**

TONGJI UNIVERSITY - Shanghai, People's Republic of China, represented by its President of the Academic Senate, Prof. Zhou Zuyi, 1239 Siping Rd. 200092 SHANGHAI, China

**and**

ALMA MATER STUDIORUM – UNIVERSITÀ DI BOLOGNA (hereafter referred to as "University of Bologna"), represented by its Rector, Prof. Ivano Dionigi, Via Zamboni 33 - 40126 Bologna, Italia

Together named "the Parties"

**Provided that**

- Within the framework of the mutual interest expressed in the Joint Statement signed by the Minister of Education, University and Research of the Republic of Italy, Fabio Mussi and by the Vice Minister of Education of the People's Republic of China, Zhao Qiping (Beijing, the September 18<sup>th</sup>, 2006) to promote and extend the institutional cooperation at university level, to be regarded as "Chinese-Italian Joint Campus".
- University of Bologna has got financial support from Italian Ministry of Education, University and Research to guarantee the commencement and development of the educational and mobility program.



REP. 2884/2014  
Prot. 30488/2014  
REG. 607/2014



- On November 13<sup>th</sup>, 2007 the Parties signed an Agreement of Interuniversity Cooperation for the granting of a first cycle double degree in Automation Engineering and subsequently they subscribed an Agreement of Interuniversity Cooperation for the granting of a Bachelor Programme on May 4<sup>th</sup>, 2012 and an Agreement of Interuniversity Cooperation for the granting of a Master Programme on May 22<sup>nd</sup>, 2012, both of them in the field of Automation Engineering.
- On April the 24<sup>th</sup> 2012 the Italian Ministry of Foreign Affairs and the Ministry of Education of the People's Republic of China signed an executive programme in the field of education for the years 2012-2015.
- Both Universities are interested in continuing their collaboration with the signature of a new cooperation agreement for the award of a second cycle degree in the field of Rehabilitation of Historic Buildings.
- The Italian Ministerial Decree "DM 270/04" allows Italian Universities to jointly grant degrees (1<sup>st</sup> and 2<sup>nd</sup> cycle) with other foreign Universities.
- The general cooperation Agreement between Tongji University and University of Bologna signed on November 11<sup>th</sup> 2011.
- Both Universities, with their resources and funds and in accordance with the law and regulations of their respective country, shall collaborate and host all students, faculty members and administrative staff who participates in the mobility program as described in this Agreement.



**Whereas**

- both parties agree to achieve complementary advantages and share resources by implementing the Double Master Degree Program (hereinafter "the program");



- both parties agree to provide the students who take the program (hereinafter "the students") with various learning and practice opportunities;
- both parties agree to cultivate qualified talents through the program. Now therefore, in consideration of the premises and covenants described hereinafter;
- rehabilitation of historic buildings is an important engineering subject concerning history and culture;
- Tongji University and University of Bologna are leading universities in this subject area in the countries respectively and the two universities are interested in developing a joint training program to foster top-notch talents with professional knowledge as well as global perspective and social responsibility.

**It is agreed and stipulated as follows:**

**Art. 1 – Preamble**

Preamble and annexes are integral part of this agreement.

**Art. 2 – Objective of the Agreement.**

The Parties agree to establish a joint educational program for a 2<sup>nd</sup> cycle double degree in Rehabilitation of Historic Buildings. At the end of the program each University will grant to participating students its degree, respectively:

- Laurea Magistrale in Ingegneria dei Processi e dei Sistemi Edilizi (Building Engineering) at University of Bologna;
- Master of Engineering in Architecture and Civil Engineering at Tongji University.



Students participating in the program shall attend course units at the partner university for a period of at least two semesters, as better specified below.

### **Art. 3 – Coursework**

#### **3.1. Study programs**

The Study program has a structure based on four semesters for Italian Laurea Magistrale and five semesters for Chinese Master. All the classes are given in English.

The courses of the double degree program offered by the two Universities are specified in Annex 1 of this agreement. All the exams that are successfully passed by students enrolled in the double degree will be recognized as part of the double degree study program (Annex 1). Students involved in the double degree program shall also enjoy the benefits and shall be likewise subject to the regulations and norms which are in force at the partner universities.

All courses and activities are in English. Students must attend courses at both partner Universities according to the double degree study program and must successfully complete requirements for the Master's Degree at each university. The study program of the double degree is detailed in Annex 1 of this agreement.

#### **3.2. Modifications to study programs**

The initial study program can be modified by mutual consent between the parties, with no detriment to students already enrolled in the dual degree program.

#### **3.3 Structure of the programme and students mobility**

Students must obtain the ECTS credits provided by the course of study as described in the Annex 1. In particular, students should successfully pass the

exams of the first year at the home university and the exams of the second year at the host university. At the end of the second year, students participating to the double degree program may obtain the Laurea Magistrale in Building Engineering from University of Bologna on the basis of a properly defined correspondence table annexed to the Agreement (Annex 1), by submitting the relevant academic documentation. The final exam can also be passed in videoconference.

Students of Tongji University applying for the Master degree of Tongji University should be back in Tongji University for an additional period of at least one semester, to finish the master thesis project. After successful completion of the studies, students can obtain the Master of Engineering in Architecture and Civil Engineering of Tongji University.

Students of Bologna University applying for the Master degree of Tongji University should stay in Tongji University for an additional period of at least one semester, to finish the master thesis project and the 12 ECTS credits in Chinese culture courses, as specified in Annex 1. After successful completion of the studies, students can obtain the Master of Engineering in Architecture and Civil Engineering of Tongji University.

Students from University of Bologna attending the supplementary semester of the second cycle degree program at University of Tongji will be enrolled on a tuition fee waiver basis; students will be insured according to article 4.6 of the present Agreement. All other charges, including health insurance, shall be borne by the students themselves.

#### **3.4. Release of the Degree**



Students successfully completing the double degree program obtain two independent degrees: the Master of Engineering in Architecture and Civil Engineering from Tongji University and the Master in Building Engineering from University of Bologna. To obtain both degrees, the students must submit the relevant documentation to each partner university according to its own rules.



#### **Art. 4 - Students**

##### **4.1 Students Exchange**

From Academic Year 2014/2015, each university can accept at maximum of 20 master students to take the program each year.

##### **4.2. Enrolment and Selection**

To be eligible for admission to the double degree program, students must be regularly enrolled in either Master of Engineering Program in Civil Engineering at Tongji University, or Master of Building Engineering at University of Bologna. The students of the double degree program should be separately admitted by both Universities. They are selected by each university according to their own criteria and modalities, which will be agreed by the relevant academic bodies in both partner Universities. Generally, the admission for the fall semester is in February. The deadline for application to the host university in order to participate to the double degree program, is agreed by the Parties. The students have to pass the TOEFL and be able to afford the expenses of overseas studying and living. The host university has the right to exclusively decide the students that they will admit to the program.

##### **4.3. Master thesis**



The research activities for the master thesis of the students enrolled in the double degree program should start in the first year at the home university and is completed in the second year at the host university. In order to strengthen and promote common research programs, two advisors, one from each partner University should guide each student.

#### **4.4 Entrance fee, Tuition fee, and Other Expenses**

Students participating in the double degree program shall be waived university admission and tuition fees, except for the degree granting fee at the host University.

All other charges, including health insurance, shall be borne by the students themselves.

#### **4.5 Certifications**

To the extent consistent with its policies and practices, each host university shall release and grant to the student attending the double degree program an independent master degree diploma and a transcript indicating his or her complete coursework and his or her academic performance and number of credits obtained at the partner university.

Students are required to write master degree theses submitted to the faculties on both sides applying for master degrees. For a Tongji student applying for double master degrees, a thesis should be written in Chinese with an abstract in English. For a Bologna student applying for double master degrees, a thesis should be written in English with an abstract in either English or Chinese and the abstract should be no less than 6,000 words counted in Chinese characters. The theses submitted will be examined by examiners

from both parties, respectively. For each side, the oral examination will be held upon approvals from examiners on the side.

#### **4.6. Insurance**

The Parties state that their respective regularly admitted students will be insured against any incident that they may suffer during their period of stay abroad for the activities concerned by this Agreement and that they are insured for legal liability against damage which they may involuntarily cause to third party (people or their properties).

#### **4.7. Services offered**

Students participating in the double degree program shall benefit from all services offered by the host university to its regularly enrolled students.

#### **4.8 Fellowships or Scholarships**

Each university can grant fellowships or scholarships to their students who intend to participate in the double degree program, on the basis of a formal internal selection procedure.

#### **4.9 Student responsibilities**

Participating students will be responsible for obtaining the appropriate visas and for complying with both institutions' academic and disciplinary standard and policies, including adhering to any and all published standards of conduct. Students will be responsible for paying the relevant tuition and fees to the host institution at which the student is then studying, minus any provided scholarship support (if any), plus the costs of textbooks and other required course materials, travel expenses, housing, meals and visa costs and all other expenses incurred during their time of study.

#### **4.10. Housing**





Students will be expected to secure their own housing and living arrangements. Both Parties agree to provide resource support (e.g., offer help to the students in their application of dormitory) according to whatever is offered to traditional students at their respective institutions.



**Art. 5 – Prevention and security**

Both parties shall supply each double degree program participant with detailed information about the specific risks existing in the work environment in which they will operate and carry out his or her function. The necessary documentation will be provided about the prevention and emergency security measures and the provisions in force in relation to his or her activity and about the individuals/subjects in charge of this, in conformity with the legislative norms and regulations in force in the country of the hosting university.



**Art. 6 – Other activities**

The parties can extend the cooperation agreement for other purposes beyond the double master degree program. Further cooperation projects, including intensive courses, distance learning, joint research, organization of seminars, symposia, and interviews on common interest topics and all other activities consolidating the cooperation, will be encouraged by both parties. These projects will be subject to specific addenda to this agreement document, and will be stipulated by both parties.

**Art. 7 – Responsibility for the Agreement**

Each university shall appoint a co-ordinator for this agreement. The signatories of this agreement or their official designees, Professor Gu Xianglin, Dean of the College of Civil Engineering for Tongji University and

Professor Ivano Dionigi for University of Bologna, may change the co-ordinator as necessary or appropriate. The initial co-ordinators are co-signatories to this agreement.

**Art. 8 –Duration of the Agreement**

This program shall become effective on the date of its signing by the representatives of both institutions for five years, which is for four (4) full cycles of the program starting from academic year 2014/2015. The terms of this agreement may be revised or modified at any time through joint review and recommendation by both institutions. This agreement shall be automatically renewed for successive five-year periods unless either party, by giving six months advance written notice to the other institution, terminates this agreement. Any modification or termination of the Agreement shall be carried out in such a way as to ensure no damage for the participants in the programs already underway. If any of the partner institutions wishes to withdraw, it must be guaranteed that all the students admitted to this institution will be able to complete their studies in the agreed way.

**Art. 9 – Controversies**

In the event of any controversy arising from this agreement the parties will endeavour to resolve the matter amicably and in good faith.

**Art. 10 – Use of name / Logo**

Each party may use the logos, names and other marks of the other parties only in connection with the program. Each party anticipates the other party's participation in press announcements, marketing and other reasonable promotional activities involving the double degree program through the appropriate use of the logos, names and marks of the parties.





## **Art. II – Intellectual property rights**

### **11.1 Background Intellectual Property**

“Background Intellectual Property” shall mean patented or unpatented and/or copyrighted or uncopied information, discoveries, inventions, improvements, data, processes, computer programs, source or object codes, documentation, texts, or other know-how owned or controlled by any member institution not arising directly from the double degree program or not otherwise subject to this Agreement.

Neither member institution shall acquire any ownership interest in the other member institution’s Background Intellectual Property by performance of this double degree program. If Background Intellectual Property is useful or essential to the practice or use of the results of the double degree program, the member institutions agree to negotiate license rights to allow the practice and use of the results of the program, to the extent that the member institutions are legally able to do so.

### **11.2 Intellectual Property**

“Double degree program Intellectual Property” means the legal rights relating to inventions, patent applications, patents, copyrights, trademarks, trade secrets, and any other legally protectable information and results, including computer, software, first made or generated during the performance of this program.

Unless otherwise agreed in writing, double degree program Intellectual Property shall be owned by the member institution that makes or generates the Intellectual Property. Jointly made or generated double degree program

Intellectual Property shall be jointly owned by the member institutions unless otherwise agreed in writing.

The joint owners will consult and take such steps as may be required to protect double degree program Intellectual Property in order to determine the most appropriate method for protection and use. All expenses incurred to protect double degree program Intellectual Property will be jointly approved and shared equally between the joint owners.

Each member institution shall be free to use on a worldwide non-exclusive basis any double degree program Intellectual Property of the other for its internal, educational and non-commercial research purposes only without the payment of royalties or other fees.

Where existing copyright material is used in a module, this must be acknowledged by the institution responsible for delivery of that module.

Member institutions will each individually confirm that strict confidentiality will be observed in any communications relating to portable or potentially commercially valuable joint degree program Intellectual Property created within the module. No disclosures will be made to third parties without permission of the appropriate authorities/person. All member institutions will, in consultation with each other, take cognisance of their policies on Intellectual property rights.

All agreements between companies and institutions in matters relating to project work must take account of the institutions' regulations concerning the availability of the final dissertation for examination purposes.

Agreements must be drawn up between companies and the institutions in respect of joint degree program Intellectual Property arising from a project.



Such agreements would take into account the student, the institution, the company and IPR ownership. Also within the agreement a statement must be made about opportunities for publication arising from the work in the project. Any secrecy clause must not conflict with the regulation of the supervising institution.



**Art. 12 – Non discrimination; Other**

All parties subscribe to a policy of equal opportunity and do not discriminate on the basis of race, colour, gender, age, height, weight, marital or familial status, ethnicity, religion, national origin or disability. Each university is dedicated to the principles of academic freedom.



There are no third-party beneficiaries to this agreement. Without limitation, no student is an intended third-party beneficiary to this agreement.

Nothing in this agreement establishes a partnership or joint venture between the universities. Each university will be solely responsible for payment of all salaries, wages, taxes, insurance, and benefits in respect of its employees.

Each university will be subject to the laws and regulations of its own jurisdiction and the policies of its institution. On reasonable notice and at reasonable times, each university (or its auditor or other representative) will be granted access to pertinent records maintained by the other, as may be necessary for a university to comply with its legal or institutional obligations.

**Art. 13 Copies and language**

This agreement is undersigned in two originals, drawn up in English.

Bologna, date 28.03.2014



Professor ZHOU Zuyi  
President of the Academic Senate  
Tongji University

Professor Ivano Dionigi  
Rector  
University of Bologna

Professor GU Xianglin  
Dean  
College of Civil Engineering  
Tongji University

Professor Francesco Ubertini  
Director  
Department of DICAM  
University of Bologna



## Annex 1

### Study Plan for the AlmaTong Double Degree Master Program in Rehabilitation of Historic Buildings

#### 1 Definition of AlmaTong Double Degree Master Program

The graduate students attending AlmaTong Double degree Master Program can apply for both the Master degree in Building Engineering of Bologna University and the Master degree of Engineering in Architecture and Civil Engineering of Tongji University.

#### 2 Credit Equivalence

The Bologna University and Tongji University adopt different criteria for the evaluation of credits. In order to establish a correspondence between the courses delivered at Tongji University and Bologna University, it is agreed the following equivalence:

1 credit of Tongji University = 2 ECTS credits of Bologna University

#### 3 Curriculum for the Alimatong double-degree Master program

The Master degree study duration in Tongji University is 2.5 years (5 semesters), while the Master degree study duration in Bologna University is 2 years (4 semesters).

According to both curricula, the teaching plan for the double-degree program is defined as follows:

##### (1) First year

*Students both from Tongji and Bologna University* accomplish the courses at the home university, given in English, according to Table 1.

Bologna University will recognize to students of Tongji University, upon completion of the year, the ECTS equivalent to the first year of the major in Master in Building Engineering in Bologna.

Tongji University will recognize to students of Bologna University, upon completion of the year, the credits equivalent to the first year of the major in Master of Engineering in Architecture and Civil Engineering in Tongji University.

**BOLOGNA STUDENTS – FIRST YEAR**

Courses @ UNIBO	ECTS	Equivalent courses @ TONGJI	Credits
Advanced structural mechanics	9	<i>Elasticity and Plasticity</i>	3
Materials and technologies for historic buildings	6	<i>Dynamics of Structures</i>	3
Survey of historic buildings	6	<i>Inspection and Evaluation of Structural Safety</i>	2
		<i>Rehabilitation Materials and technologies for historic buildings</i>	2
Conservation Theory of Historic Buildings and heritage conservation	9	<i>Conservation Theory of Historic Buildings and Heritage Conservation</i>	9
Materials preservation for cultural heritage	6	<i>Materials Conservation for Cultural Heritage</i>	4
Historic masonry and wood structures	9	<i>Historic masonry and wood structures</i>	5
History of Italian/European Architecture	6	<i>History of Italian/European Architecture</i>	1
Master thesis A	9	<i>Dissertation A</i>	5



**TONGJI STUDENTS – FIRST YEAR**

Equivalent courses @ UNIBO	ECTS	Courses @ TONGJI	Credits
Advanced structural mechanics	9	<i>Elasticity and Plasticity</i>	3
Materials and technologies for historic buildings	6	<i>Dynamics of Structures</i>	3
Survey of historic buildings	6	<i>Inspection and Evaluation of Structural Safety</i>	2
		<i>Rehabilitation Materials and technologies for historic buildings</i>	2
Structural strengthening & rehabilitation	6	<i>Structural Rehabilitation and Strengthening</i>	2
Structural diagnostics and seismic assessment	9	<i>Advanced Experimental Techniques in Structural Engineering</i>	2
		<i>Earthquake Engineering</i>	2
		<i>Probability Analysis in Civil Engineering</i>	2
Elective courses	15	<i>Applied Statistics</i>	3
		<i>History of Chinese Architecture</i>	3
		<i>Traditional Building Structures in China</i>	2
Master thesis A	9	<i>Dissertation A</i>	5





Table 1.

(2) Second year

Students both from Tongji and Bologna University accomplish the courses at the host University, given in English, according to the plan shown in Table 2.

Bologna University will recognize to students of Tongji University, upon completion of the year, the ECTS equivalent to the second year of the major in Master in Building Engineering in Bologna. Tongji University will recognize to students of Bologna University, upon completion of the year, the credits equivalent to the second year of the major in Master of Engineering in Architecture and Civil Engineering in Tongji University.

BOLOGNA STUDENTS – SECOND YEAR

Structural diagnostics and seismic assessment	9	Advanced Experimental Techniques In Structural Engineering	2
Structural strengthening & rehabilitation	6	Earthquake Engineering	2
		Probability Analysis in Civil Engineering	2
		Structural Rehabilitation and Strengthening	2
Elective courses	15	Traditional Building Structures In China	2
		History of Chinese Architecture	3
		At least 3 credits from the following list:	3
		Advanced Theory of Concrete Structures (3)	
		Underground structures (3)	
		Finite element method (2)	
		Geo-environmental engineering (2)	
		Applied statistics (3)	
Master thesis B	30	Dissertation B	14.5

TONGJI STUDENTS – SECOND YEAR

Historic masonry and wood structures	9	Historic masonry and wood structures	9
Materials preservation for cultural heritage	6	Materials preservation for cultural heritage	6
History of Italian/European Architecture	6	History of Italian/European Architecture	6
Conservation Theory of Historic Buildings and heritage conservation	9	Conservation Theory of Historic Buildings and heritage conservation	9
Master thesis	30	Dissertation B	15

Table 2.

The Master degree in Building Engineering of Bologna University can be granted upon completion of the courses listed in Table 1 and Table 2.

(3) **Fifth semester**

According to the rules of Tongji University, the Master degree program in Tongji has a duration of five semesters.

*Students from Bologna University* applying for the double program must attend an additional period equivalent to a semester in Tongji University. During the total three semesters in Tongji, they must attend additional courses in Chinese culture and language for a total of 6 Tongji credits (12 ECTS) as shown in Table 3.

For students from both Tongji and Bologna, the master thesis should be prepared during the second year, and should be finished in the fifth semester. The students must finish the defence in this semester in home or host university. The defence committee should include professors or experts from both Tongji and Bologna. Accordingly, the defence will be carried out simultaneously by the long-distance visual network system.

A formal academic paper is also required to be published in the academic journal or the international conference in order to apply for the Master of Engineering in Architecture and Civil Engineering of Tongji University



	Credits	ECTS
Elementary Chinese	3	6
A General View of China	3	6

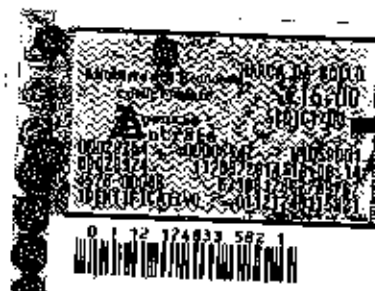
Table 3: Courses delivered at Tongji University for students of Bologna University.

For students of Bologna University, the Master of Engineering in Architecture and Civil Engineering of Tongji University can be granted upon completion of the courses listed in Table 1, Table 2 and Table 3.

For students of Tongji University, the Master of Engineering in Architecture and Civil Engineering of Tongji University can be granted upon completion of the courses listed in Table 1, Table 2 and additional educational activities as required by the Master of Engineering in Architecture and Civil Engineering of the Tongji University.

Candidate students may submit an individual study program to anticipate some courses of the second year to the first one and vice versa or to select elective courses that are not listed in the

above tables. In exceptional cases, some courses may be substituted, upon valid motivation, according to individual study program. In any case, the individual study program must be approved by both parties.





## **Brief Description of Courses**

### **➤ Elasticity and Plasticity**

*The basic concepts and notations of vector and tensor analysis are introduced. A novel approach to the analysis of stress and strain is presented, which not only elucidate these principles but provide a clear physical understanding as well. The general assumptions used in the formulation of elasticity-based constitutive models are explained. It is extended to the elasticity-based stress-strain models to the plastic range. Plasticity-based models for engineering applications are developed.*

### **➤ Dynamics of Structures**

*This course serves as the basic course for dynamic related research, and explores in greater depth the fundamental mathematics invoked to richly describe dynamic system behaviour. The course introduces the fundamental theories related to structural dynamics, and covers topics such as the dynamic response of structures modelled as single-degree-of-freedom systems and multi-degree-of-freedom systems, response of the linear systems to harmonic, periodic and arbitrary excitations, earthquake response of linear systems, and free and forced vibrations.*

### **➤ Earthquake Engineering**

*The fundamental objectives of the course is training the students to gain knowledge of the basic concepts of earthquake engineering, to master the analysis method of linear/nonlinear structural response subject to earthquake, to know measurement and identification of structural dynamics characteristics, to understand the analysis principle of stochastic seismic response of structure and the advanced disaster prevention technologies.*

### **➤ Probability Analysis in Civil Engineering**

*The course is made up of basic theories and methods for risk assessment in civil engineering. Students will master the theories of risk identification, risk analysis, risk assessment, and risk control in a systematical way. Furthermore, they can well understand the methodologies and current techniques for risk management in civil engineering planning, design, construction and operation.*

### **➤ Advanced Experimental Techniques in Structural Engineering**

*The fundamental objectives of this course is training the students to observe various laboratory tests, to expose to a variety of established testing techniques, to master basic theories of model design for lab testing, to learn data processing methods and instrumentations, to get hand-on*

experiences of testing design , implementation and result presentations, to be educated to write technical reports.

➤ **Inspection and Evaluation of Structural Safety**

The concept of life-cycle maintenance is introduced in the course. The course covers sampling theory of on-site inspection, on-site strength evaluation, damage inspection, structural analysis of damaged structural members, reliability-based assessment theory and method for existing building structures.

➤ **Structural Rehabilitation and Strengthening**

The course seeks to provide the students with the knowledge of available techniques and their application for strengthening or upgrading existing structures. The course covers repair and strengthening materials, strengthening and repair techniques, strengthening of structural members in flexure, shear and axial load, upgrading of gravity load-designed buildings for earthquake load resistance.

➤ **Traditional Building Structures in China**

This course offers a comprehensive guide to the traditional building structures in China from the past to the present. The course emphasizes the history, theory, analysis, and construction of traditional building structures in China, including wood structures, masonry structures, concrete structures and steel structures

➤ **Rehabilitation Materials and Technologies for Historic Buildings**

The course is centered on the conservation and repair of traditional and historical building fabrics and archaeological monuments. The course covers analysis, assessment, and reproduction of historical building materials, causes and mechanisms of decay of historic building materials, compatibility of new technologies with historical building materials.

➤ **Conservation Theory of Historic Buildings**

*Heritage conservation and development*

The course will be focused on history of architectural conservation and on the evolution of the concept during the two last centuries. Anyway, a short mention to the origins of the interest in conservation within the European context and the development of the concepts from Antiquity and the Renaissance will be given. The evolution of values will be emphasized from traditional to modern society, and the challenges of the present built environment.

➤ **Survey of Historic Buildings**



*The course will be focused on the evaluation of a historic building to establish its significance as a individual structure, to record its relationship to its surroundings and landscape and the aspects of its construction, design or purposes. As well as to the methodologies to provide an accurate measured and photographic record and analysis of the historic fabric and structure, materials and decay phenomena, the survey should also include an understanding of how the building was used and the processes involved in its development and past/future uses.*

➤ ***History of Italian/European Architecture***

*The course aims at teaching methods and tools to analyze and understand architectural buildings and spaces, from the Ancient times to the Modern age, with particular attention to: relationships between forms and structures; building materials and techniques; aims of the clients and the architects; connections with previous and contemporary architectures.*

*Lessons will take place in lecture rooms, showing slides and images and analyzing the suggested topics paying attention to architectural forms, building typologies and techniques; exercises will consist in visits to some of the analyzed architectures as well as in examinations of single buildings or complexes. During lessons and exercises the student will be invited to analyze and discuss the proposed items, learning to critically analyze architectures as well as relationships between forms and building techniques.*

➤ ***Materials and technologies for historic buildings***

*The course aims at providing students with:*

- a solid understanding of the development of historic buildings through the examination of their materials and construction techniques, especially focusing on stone, wood and masonry;*
- the basic knowledge in Applied building pathology;*
- a set of criteria useful to ensure that the materials selected for conservation and restoration are best suited to the needs of each project in terms of safety, efficiency, compatibility and cost effectiveness, as a palette of variables that the design must manage simultaneously.*

*Pre-industrial building materials, structural systems, technologies and tools will be studied. Their evolution, deterioration, and repair will be also discussed through the analysis of conservation, repair and restoration case-studies.*

➤ ***Historical Masonry and Wood Structures***

*The goal of the course is to provide students with the fundamentals for the analysis of historical masonry and timber structures. In particular, the course deals with the theoretical aspects, the*



numerical tools and the experimental tools for an effective structural diagnosis of historic structures for conservation or rehabilitation. Structures from different periods are analysed.

The course includes the following contents.

- *Masonry and Timber systems in Historical Constructions. Relevant phenomenology regarding collapse. Provisional support and Reconstruction after collapse of historical constructions.*
- *Standards and Experimental Evidence on masonry and timber prototypes. Non destructive tests for collecting mechanical parameters (physical lab vision).*
- *Theories and models of structural behavior of masonry. Examples of applications (numerical lab hands-on).*
- *Case Studies (Ghirlandina Tower, Rialto bridge).*

➤ *Advanced Structural Mechanics*

The course is an extension and intensification of *Mechanics of Solids and Structures*. The overarching goal of the course is to advance the understanding of structural behavior and enhance the ability to apply classical structural analysis methods to civil engineering systems, with emphasis on historical buildings.

The main contents of the course are:

- *overview of classical methods for structural analysis,*
- *elastic analysis (linear), structural matrix analysis (computer-based simulations),*
- *plastic analysis, limit analysis,*
- *fundamentals of structural dynamics.*

The course includes laboratory sessions, which cover practical aspects of the lectures.

➤ *Structural Diagnostics and Seismic Assessment*

The goal of the course is to provide students with advanced concepts and tools for structural diagnosis, experimental testing and seismic assessment. Special attention is paid to non-destructive techniques and in-situ structural assessment.

The course includes:

- *documentation of historic structures, typical damage and visual inspections,*
- *in situ investigation, non-destructive and slightly destructive techniques,*
- *laboratory load tests, modal testing,*
- *fundamentals of structural health monitoring,*
- *seismic assessment, response spectrum analysis, damage and collapsing mechanisms in existing*





(particularly historical) structures,

- case studies.

➤ **Structural Strengthening and Rehabilitation**

*The course is designed to provide students with the knowledge of available techniques and their application for strengthening or upgrading existing structural systems, with special emphasis on historical structures.*

*The course includes:*

- *assessment of materials and structural deficiency using field test or analytical methods,*
- *repair and strengthening materials,*
- *strengthening and repair techniques,*
- *strengthening of structural members in flexure, shear and axial load,*
- *upgrading of gravity load-designed buildings for earthquake load resistance.*

➤ **Materials preservation for cultural heritage**

*The course provides the students with the basic methodological tools for a correct selection and application of materials and technologies for the conservation of historic building materials, with particular care to the issues of effectiveness, compatibility and durability. In addition, it provides with basic knowledge of microbiology and biotechnology required for understanding the role of microorganisms in the biodeterioration of cultural heritage and their possible implication in the prevention and conservation of the materials and the restoration of altered ones.*