

RESTORATION LABORATORY CLASS AND THE ROLE OF GEOMATICS IN CULTURAL HERITAGE EDUCATION

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ABSTRACT

Conservation-restoration education has been discussed in context of teaching methods, curriculums, quality of courses and interdisciplinary relations since Bologna Declaration has started. Conservation-restoration classes are generally devoted to give general knowledge about theoretical background of restoration and to make some practices related to theoretical part with preparation of restoration project. In recent years, innovative technologies have given different opportunities to conservation-restoration practice and its education as well. University of Florence Restoration Laboratory class gives both theoretical and practical courses with innovative approach and interdisciplinary study. In this course GECO³ Laboratory provides methodologies and tools with new techniques in documentation/surveying and analysis of cultural heritage. This support would be very effective for students' future studies and practices in their professional life. The aim of this paper is to represent an approach to conservation-restoration education adopted by University of Florence, to explain possible integration between different disciplines and to emphasize the significance of geomatics laboratories in conservation-restoration education.

Keywords: Conservation-Restoration Education, Geomatics for Architecture, University of Florence, Educational Activities

1. INTRODUCTION

Conservation-restoration education is a part of contemporary architecture education and a practice of architecture directly affected by social, technological and cultural transformation of today. Valuable monuments, sites and landscapes are increasingly being threatened by large scale or uncontrolled developments of the built environment (Verpoest et al., 2008). Recent environmental and cultural degenerations prove that conservation-restoration practice has become more important than in the past. Conservation-restoration education as a combination of diversity theoretical knowledge and practical skills is expected to find appropriate balance between the theoretical knowledge and practical training in basis of this education (Crăciunescu, 2008). Moreover, since this education has strong relation with some cultural, historical, aesthetic and technical issues (Hutchings, 2009; Loughlin, 2008), conservation-restoration education can be organized with interdisciplinary curriculum which includes theoretical background of conservation-

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restoration practice, solutions for some problems of cultural heritage, knowledge of materials properties and their behaviors in different conditions, techniques related to preventing deformations, different restoration techniques, new design methodologies in historic building/environment as well as documentation of cultural heritage.

Context of cultural heritage education has been discussed over the last two decades and several methods have been used for conservation-restoration education. During Bologna process, the conservation-restoration education programs in most European countries have undergone great changes including adoption of University of Florence structure. The original recommendation of Bologna Declaration was a call for an introduction of a common two-tier education; three years undergraduate and two years graduate studies. This recommendation was based on shared academic values and principles and the goal of it was to foster mobility of student, teacher and researcher for enriching education (Winter and Ogleby, 2008). Addition to Bologna recommendations, European Minister of Education has a declaration aimed at creation of a single European Higher education commonly referred to Bologna declaration. E.C.C.O. (European Confederation of Conservator-Restorer' Organization) involves guides and recommendations on conservation-restoration education and professional competences of cultural heritage area. This guideline addresses its own requirements for professional work including education qualification. Some of European universities have already deep experiences on conservation-restoration education and have been changing their education systems based on Bologna declaration and European Union suggestions.

Recent researches have shown that studies related to conservation-restoration education commonly concentrate on development of education and professional work quality. Observation of learning outcomes can change academic emphasis of education from what educators wish to teach to what graduates need to know. These learner-centered approaches can be reorganized in courses that require a well-defined curriculum in order to provide access to professional working platform (Hutchings, 2009). This is directly related to how an educator should convey concept and forms during teaching. It's one of the aim to teach students how regularly attendance to a class can help to tackle with many problems in professional life both culturally and technically. Restoration project class is a main course generally most of the universities give knowledge to students both in main theoretical field and how to come across with different problems. An integrated and multi discipliner curriculum is followed in Restoration Laboratory class for 3-year bachelor degree students in University of Florence. Main important part of this curriculum is devoted to documentation of historical buildings with modern techniques.

Data collection and recording is very important and the main part of cultural heritage studies related to ICT (Information and Communication Technology). Especially 3D data acquisition has been important for analyzing data, recognizing of problem, education activity and dissemination knowledge in recent decades (EPOCH, 2008). In this context, with awareness of future technological development and innovations, most of educators believe that new techniques and innovative approaches should take place in conservation-restoration education. This approach is not just a documentation process of architectural heritage; it is also

related to full understanding of cultural heritage and ICT relation. In this context, Geomatics laboratory provides teaching to students who will be professional profiles after graduation of university. This paper aiResearch Agendams to present that Geomatics education as a part of architectural education should be a way in order to prepare students better for their professional life shaped by fast developing technology.

2. CONSERVATION-RESTORATION EDUCATION IN UNIVERSITY OF FLORENCE

Italy is a rich country to find different kinds of programs related to cultural heritage for researchers and students. Conservation-restoration education in University of Florence teaching approach has deep relations with establishment of Conservation Institute (1960) and the founder of the institute Piero Sanpaolesi (1904-1980). Sanpaolesi played a major role in growth of the international conservation method in 1960's and 1970's in Italy. Sanpaolesi, primarily suggested to rediscover of historic architecture built in previous centuries by different nations. After awareness of historical architecture, he promoted crucial discussions in international level on restoration criteria and methods. In these discussions, people tried to find a compromise on what would be considered as acceptable restoration work. According to Sanpaolesi, restoration education needs to integrate theoretical learning and some experiences gained on the field works. Sanpaolesi also emphasized that restorer architects had a main coordinator role in various types of projects and constructions in order to control their preservation measures and their compatibility with historic context. Moreover, he mentioned that restorer architects are guarantor of restoration works quality and operations of preservation institutions in different places and at different levels (Devita, 2008). In this historic background, it should be emphasized that conservation-restoration education in University of Florence has continued without any interruption since conservation institution was established. Main objectives of teaching activity in University of Florence can be summarized as:

- to improve learning, research for active protect of cultural, historical and natural heritage.
- to understand cultural heritage with in its physical consistency and construction process.
- to get potential in order to exchange knowledge and experiences with different disciplines related to cultural heritage.
- to have ability to solve problems related to cultural heritage by modern techniques, concepts, restoration and preservation methods.
- to improve capability for using modern acquisition and dissemination techniques in cultural heritage field.
- to increase knowledge regarding to cultural heritage and its behavior in different conditions in order to improve the restoration.

Table 1. Summary of Conservation-Restoration Teaching in Italy (De Naeyer, 2008).

Summary of Conservation-Restoration Teaching in Italy	
1	<p>Bachelor degree in Conservation of Cultural Heritage:</p> <p>Three-year full time education aiming at good professional competences in the field but without important civil responsibilities.</p>
2	<p>Introductory courses for architectural and urban conservations.</p> <p>This course integrated in master programs in order to give a basic acquaintance with some principles of conservation (Theoretic and technical). Generally 1 hour in a week in one semester (3ECTS course).</p>
3	<p>Master in Architecture</p> <p>Regular architectural education consists of 5-year program (3-year bachelor followed by 2-year appropriate master). This master program is in the second part of regular architecture education with specialization in conservation-restoration.</p>
4	<p>One year Master Programs</p> <p>These programs are different from master in architecture and the alumni are not allowed to take the civil responsibilities of an architect in architectural projects. These type of master programs (with entrance of student into diverse fields) have the advantage of offering a widely inter and multidisciplinary approach in the study program. 1 year: (60 ECTS) or 2 years: (120 ECTS)</p>
5	<p>Postgraduate academic master programs or Master after master Programs.</p> <p>These are multidisciplinary specialization from 60 to 120 ECTS organized for architects, engineers or who have masters from human sciences to get specialized in architecture and urban conservation of monuments. The condition to start such postgraduate master programs is to have a first master diploma related to conservation of build heritage.</p>

6	Phd programs.	Such studies can start after an academic master degree and always consist of authentic and original scientific researches.
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3. ICT AND GEOMATICS LABORATORY FOR CONSERVATION- RESTORATION EDUCATION

Progress in Information & Communication Technology (ICT) has quickly changed our standard of life, the way of working, teaching, studying and the way of carrying out research. Cultural heritage studies cannot neglect these technologies as they are a way to reach a new and greater population of users and to get and share more information (Petrone, 2012). Also in education field, the role of ICT in teaching and learning brings changes to digitalization of cultural heritage artifact, to view them as 3D in digital platforms and to share data with different stakeholders (Ott and Pozzi, 2011). This sharing is significant for *effective interpretation and presentation of cultural heritage for enhance personal experience, increase public respect and understanding and communicating* (ICOMOS, 2007). Geomatics Laboratory (GECO) organizes a sort of atelier aiming to emphasize the role of innovative techniques in documentation and conservation of cultural heritage.

Main objective of teaching activity in this geomatics laboratory are:

- to give general information related to new techniques for cultural heritage and environmental documentation (small object documentation, photogrammetric techniques for building and large areas and laser scanning techniques).
- to use modern survey techniques to understand of whole morphology of buildings and site to make decisions (with topographic survey, laser scanning and photo-base modelling).
- to produce 3D models and ortho-images to analyze shape of objects, anomalies, material differences and structural problems and to transfer these data to related disciplines .
- to get some experiences with interdisciplinary study in restoration project class (with geomatic engineers, construction and environmental engineers, historians and restorers).
- to understand how important dissemination and sharing of data for education and scientific proposes.
- to get practice to present all data with different graphic expressions (3D modelling programs and graphic design programs).

These objectives also contain some on-site analysis, diagnoses as well as preparing some reports for actual situation of building and sites for conservation and restoration process.

4. SOME EXPERIENCES FROM CONSERVATION-RESTORATION LABORATORY CLASS

Traditionally, conservation-restoration education is based on both theoretical and practical approach in department of architecture. Teaching conservation-restoration education aims at giving basis of conservation and restoration history, analyzing of historic architecture, giving methodology for survey techniques, understanding of spatial units and geometry of building, figuring out structural and material features of building and site besides drawing a restoration project analyzing with all acquired data. Conservation-restoration laboratory class in University of Florence consist of three different courses and three different steps: Theoretical background, Field work, Restoration project.

Table 2. Restoration Laboratory Course Sections.

Restoration laboratory course sections and their descriptions		
	Section	Description
1	Geomatics for Conservation/Restoration	Modern survey techniques
2	Restoration	Theoretical background & project
3	Static and Stability for Conservation	Material and Structural Behaviors.

-Theoretical Background

Each year, as educator, which theoretical and technical principles are leading conservation-restoration classes and educational goals which should be persuaded are discussed. The beginning of course is generally dedicated to intervention on historical architecture. History and theory of conservation, legislations related to conservation-restoration practice are given more in theoretical part of the course. Subsequent work of conservation-restoration works are exemplified and critical commentary of conservation-restoration works and some good or misrepresenting works are evaluated and interpreted in the class. Current theoretical debates and most recent themes and solutions dealt with in Italy and the rest of Europa are debated in theoretic part of this course. New approaches for conservation-restoration works and reusing of historical buildings, restoration techniques, new scientific academic researchers are presented to students for helping their restoration projects. Conservation-restoration should be taught as heritage care application in which different kind of disciplines can take part of this didactic activity (Torsello, 2008). In this part, some interdisciplinary presentations are carried on in our curriculum. Depending on the case study, some history and art-history, environmental relations, landscape and urban planning presentation take place in theoretical part. Historical and most common current materials for restoration applications, technical and structural characteristic of buildings, urban conservation and related regulative references are studied in conservation-restoration class with structural and material engineers, urban planners and historians. About thirty years ago, architectural heritage was primarily understood as a single building or building groups that were

valuable for conservation in the Charter of Venice (1964). Today a more in depth approaches are advocated which identify various dimensions and aspects of architectural heritage. Recent studies represent that cultural heritage issue is very complicated and it clearly needs interdisciplinary studies.

In theoretical part, connection with practical part, educators are tried to answer general questions regarding consolidation, maintenance, modification, integration, new additions and technical operation in context of destiny of built heritage, of an environment, of way life, of a landscape through a clear design process (Franco, 2008). In this class, description of architectural buildings peculiarities, surface analyses, analysis of deformations, crack analysis, sign of material decays and long-time behaviors of material and building components are studied. Students can apply this theoretically developed knowledge in their individual conservation-restoration projects as thematic maps to recognize and represent structural problems, material differences, anomalies, cracks and risky parts. The material evidences of the monuments in theoretical part are especially focused on conservation and restoration projects.

-Field Work and Metric Survey

The training courses are process of connection between theoretical considerations and operational answers that are direct examinations (manual or instrumental surveys, geometrical technological and material studies, structures and walls) and studying on bibliography and sources (Fiorani, 2008). The practice runs parallel to theoretical lessons with building survey and analytical studies. Students develop a field study for diagnosis and analysis of current situation of building and study on historical changes, different additions and authentic situation of building. Acquired data is collected in an analysis report for using design phase or restoration project. Different possible restoration techniques are compared and discussed using on-site study report. On-site study consists of these steps:

- Survey of historical building
- Diagnosis of problems and historical studies.
- Synthesis of acquired data as a report for using restoration project.
- Elaboration of restoration project using with this data.

Traditional metric survey and modern documentation techniques are taught in restoration laboratory. In contrast to photogrammetry and laser scanning technology, direct survey and topographic survey are taught as traditional survey techniques. Choosing single subjects for small study groups study independently on a survey project for leaving them free to follow theoretical part supported by laboratory educators. Direct measurement techniques are basis of survey projects and still used in most of restoration projects and are given in different courses in department of architecture. In conservation-restoration class, students use direct measurements supported by topographic measurements. Basis of topographic survey techniques and equipment, how restorer can manage topographic survey and elaborate topographic data in office or CAD programs are in this process.

Terrestrial laser scanners and photogrammetry are increasingly being used for 3D cultural heritage documentation works. It is not possible to know or understand some problems of building without complex survey including whole building. These new technologies provide detailed knowledge related to whole building. One objective of these courses is to get student familiar with these kinds of technologies for their future professional life and education. Photogrammetry is generally used for obtaining ortho-images for drawing of building façades easily. Façades of case study are studied in photogrammetric software, and then elevations of building are drawn with ortho-images. This technique is very effective for thematic drawings and analyses of building facades. Similarly, some part of case study is scanned with students to explain laser scanning technologies and its working principles. After scanning of building, in laboratory, management of laser scanning data is explained and some section, elevations and plans are prepared for students to draw and to use in their survey project. Thanks to facilitation of the laboratory, it was easier to teach students how to use nondestructive techniques for acquiring data of historical building and diagnosis of their conservation conditions as a fundamental support of conservation-restoration education.

-Restoration project

Restoration project is main part of conservation-restoration education. Student can find an opportunity to solve same problems and to combine theoretical and practical requirements as a one goal of the restoration laboratory. This part of the project concern how can be kept a historical building alive with some conservative, maintenance, re-using interventions. Student can try possible different restoration alternatives in this process discussing with educators.

Another goal of architectural restoration project is to examine re-using alternatives with comparing physical character of building by preserving with authentic space character or reusing building with new additions. This is more related to design activity in historic district or building with modern restoration approaches. The design activity related to historical building and site contains trans-disciplinary approaches in order to cope with some problems of design area especially regarding old and new relations in historical area. In addition, design activities combined with restoration projects have interdisciplinary dimensions related to cultural studies, sustainable activities in building and its environment. In the restoration project, educators aim to be sure that attendance of the class make correct assessment of the links between cause and effect in analyzing process and it is expected to use this data in restoration project to find solutions for cultural, technical and operational domain.

5. CONCLUSION

University of Florence has deep conservation-restoration background starting from the contribution of Piero Sanpaolesi. Recent years conservation-restoration

education has been improved by objective of Bologna declaration process and European Union suggestions. Following this suggestion, University of Florence conservation-restoration education is getting more interdisciplinary and focusing on different related areas. We always consider that how can we improve quality of this courses in context of administrative structure, over all concept of curriculum and methods of teaching. After 3+2 years architecture education in University of Florence, students can be familiar with some very important classic and modern issues related to the conservation-restoration:

- General theoretical background of conservation-restoration practice.
- General knowledge of technical and scientific methods for cultural heritage documentation: from direct survey to laser scanning technologies.
- General knowledge related to legislations for conservation-restoration.
- Critical awareness of knowledge related to different issues between conservation-restoration field and different disciplines (material studies, structural problems, analysis of all anomalies and graphical expression of these topics as a project or deformation maps).

It is clear that the use of geomatics technology provides a significant contribution to conservation practices. This technology is getting increase and in near future, it will be essential for all discipline in cultural and environmental documentation. Architectural schools/departments/institutes should provide this technology for their student as a main profile which will need this technology in cultural heritage studies. This technique is not a measurement of objects/buildings; it also contains some opportunities for extensive researches on studied objects. In order to get common use of innovative technologies in restoration projects, it has been concluded that adequate training/education should be given in universities and this technology should be taken place in architectural education. This course inspires graduated students more to use this technology in their professional works and to apply it to interdisciplinary programs related to documentation of historical building and sites.

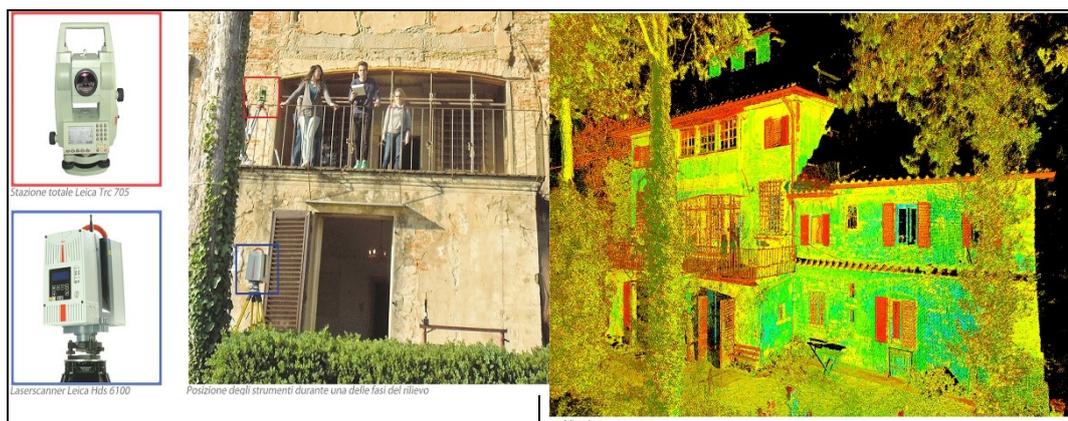


Figure 1. Topographic survey and laser scanning for support to restoration laboratory (GECO Lab.).

Figure 2. Students getting familiar with working on laser scanner data (GECO Lab.).



Figure 3. Ortho images for thematic maps for material analysis (Restoration Lab. 2014).



Figure 4. Ortho images for thematic maps for deformation analysis (Restoration Lab. 2014).



Figure 5. Restoration project with new design approach in historic building (Restoration Lab.).

2014).



Figure 6. Some graphical expression of student for restoration project in graphic software (GECO Lab.).



Figure 7. Point cloud data for elevation, section, plan and 3D models (GECO Lab.).

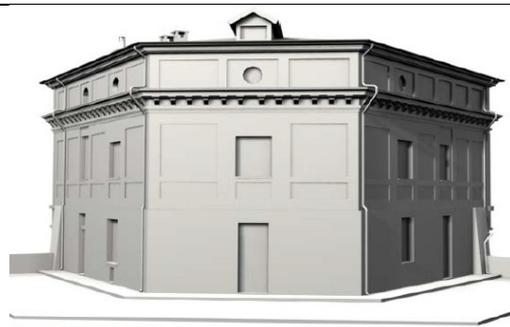


Figure 8. 3D model of building, created by using point cloud (GECO Lab.).

REFERENCES

- Arnold, D., Geser, G., 2008, EOPCH Research Agenda for the Application of ICT to Cultural Heritage, Full report of European Union Project.
- Bologna Declaration, Reference from Internet:
http://www.eua.be/eua/jsp/en/upload/OFFDOC_BP_bologna_declaration.1068714825768.pdf (date of connection: 2014)
- Crăciunescu A., 2008, Why Teaching Conservation at all in a Mercantile Society?, Teaching Conservation/Restoration of the Architectural Heritage Goals, Contents and Methods”, Editors:Stefano F. Musso, Luisa De Marco, EAAE publishing, pp:68-71.
- De Naeyer, A., 2008, How do we Teach?, Chapter of “Teaching Conservation/Restoration of the Architectural Heritage Goals, Contents and Methods”, Editors:Stefano F. Musso, Luisa De Marco, EAAE publishing, pp:164,172

- De Vita, M, 2008, Thoughts on the Teaching Restoration: The Preservation Project Today, Editors:Stefano F. Musso, Luisa De Marco, EAAE publishing, pp:315.
- E.C.C.O. Professional Guidelines III Basic Requirements for Education in Conservation- Restoration, adopted by its General Assembly, Brussels 2 April 2004
- EPOCH Research Agenda for the Applications of ICT to Cultural Heritage. European Union Research Project final Project Report, pp.53-54
- Fiorani, D.,2008, The Teaching of Architectural Restoration on Degree Course in Constructional Engineerin-Architecture at the University of L'Aquila, Editors:Stefano F. Musso, Luisa De Marco, EAAE publishing, pp:207-214.
- Franco G.,2008, Technology of Architecture towards Conservation, Teaching Conservation/Restoration of the Architectural Heritage Goals, Contents and Methods”, Editors:Stefano F. Musso, Luisa De Marco, EAAE publishing, pp:74-84.
- Hutching, J.,2009, Developing an accountable system of Conservation- Restoration Education at Oslo University thought the use of learning outcomes, ENCoRE Journal, v:2/2008, pp:3-15.
- ICOMOS, 2008, Charter for Interpretation and Presentation of Cultural Heritage.Reference from Internet: http://icip.icomos.org/downloads/ICOMOS_Interpretation_Charter_ENG_04_10_08.pdf_(date of connection: 2014).
- Loughlin, K., 2008, Teaching / Thinking / Learning / Doing Conservation and Creativity in Architectural Education, Chapter of “Teaching Conservation/Restoration of the Architectural Heritage Goals, Contents and Methods”, Editors:Stefano F. Musso, Luisa De Marco, EAAE publishing, pp:42,48
- Petrone, M, 2012, Cultural Heritage in an information/communication based society, Neothemi, Cultural Heritage and ICT at a Glance, Project report, Editor: Seija Karppinen, Helsinki pp:97-99.
- Ott M., Pozzi F., 2011, Towards a new era for Cultural Heritage Education: Discussing the role of ICT Computers in Human Behavior 27 (2011) 1365–1371.
- Torsello P. 2008, Method, Procedures, protocols, Chapter of “Teaching Conservation/Restoration of the Architectural Heritage Goals, Contents and Methods”, Editors:Stefano F. Musso, Luisa De Marco, EAAE publishing, pp:27,31.
- Verpoest L., Neuckermans H., DE Jonge K., Van balen K., 2008, An Intercultural and Interdisciplinary Teaching Approach in Conservatio, Chapter of “Teaching Conservation/Restoration of the Architectural Heritage Goals, Contents and Methods”, Editors:Stefano F. Musso, Luisa De Marco, EAAE publishing, pp:33,37.
- Winter S, Ogleby CL., 2010, Geomatics Education in the Spirit of Bologna. German Society for Photogrammetry, Remote Sensing and Geoinformation 3 Country meeting. ISPRS Wien., pp. 87 - 95.