A multi-disciplinary approach to the preservation of cultural heritage: a case study on the Piazzetta degli Ariani, Ravenna

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Abstract—The Interdepartmental Centre for Industrial Research (CIRI) – Building and Construction of the University of Bologna is a ‘cross-over’ research board composed of several departments whose scholars come from different disciplines, their aim is to work together, share their know-hows, and debate issues from different points of view. The pilot project concerns the ‘Square of the Arians’, Ravenna, Italy, suffering from chronic problems of physical and social deterioration, despite the fact that the Arian Baptistery is part of the Unesco World Heritage List. Moving from an analytical historical study of the site and of its resources, a large-scale operational project led to the reconstruction of different diachronic phases of the site through 15 centuries of history and has produced a 3D reconstruction and Virtual Tours for remote and mobile visualization. The results were displayed in July, 2013 by a conference and an open, multimedia exhibition in the Square itself, comprising 3D modelling, videos, internet-based support utilities, etc. Such a project represents a successful and flexible result to be adapted to different cases in the field of the preservation of the Cultural Heritage.

Keywords—digital heritage; 3D modelling; augmented reality; diagnostics of cultural heritage; multi-disciplinary research.

I. INTRODUCTION

Nowadays the discipline of preservation of cultural heritage must consider many different aspects. A historical building composed by various elements, including its meaning and its purpose at the time of its creation; a history of modifications and changes; a conservative history characterized by anthropic and natural deterioration. In order to operate on a monument – or on a group of monuments – it is essential to know as much as possible about such aspects, drawing from many different disciplines. It is necessary, first of all, to learn the historical processes which allow to correctly read the original meaning and value the building used to have. It is also essential to know in detail the materials composing the building, as they may allow to date not only its creation, but also the subsequent modifications made over time. Furthermore, it is important to define the ‘health status’ of a monument in order to understand the degree and causes of decay phenomena. A further relevant aspect is to understand the value, and the resulting valorisation potential, of the history of a building. This means to arouse the interest of a broad and varied audience, employing languages and means of communication both informative and user-friendly. Such approaches, today, plays a crucial role by supporting the researchers in the scientific study and analysis of data, the correlation of different types of information and their interpretation, along with the educational and informative presentation of the results [1].

II. CIRI BUILDINGS AND CONSTRUCTIONS: RESEARCH AND ACTIVITIES

The Interdepartmental Centre for Industrial Research on Buildings and Construction Technologies (CIRI EC) of the University of Bologna promotes research co-operation and innovation within industries, small/medium enterprises, and institutions, by means of technological support, knowledge transfer and business development.

Strong background and outstanding expertise in several aspects of the Buildings and Construction studies and techniques are the key assets that our personnel brings in important research projects.

The CIRI EC is set into different Research Units: the Unit of Innovative technologies applied to the restoration, recovery or requalification of built heritage - Composition and restoration of materials, also called Recovery and Restoration (R&R), includes about 85 professors and researchers and 20 technicians belonging to disciplines such as Architecture, Physics, Chemistry, Virtual Heritage and Digital Humanities, Engineering, History, Visual Arts, Law, Classics, Archaeology, etc. The CIRI EC is developing an approach to the field of preservation of Cultural Heritage based on practical experiences in order to identify new parameters and procedures around key topics such as access to monuments, large-scale communication of the results, use of modern technologies, and an all-around study of the subject from its history to its past and present problems, to possible solutions and improvements.
Such set of different skills are focused on a single purpose: allowing an all-around knowledge and study of the cultural artefact. It is thus possible to arrange a proper plan of intervention, conservation and enhancement. The laboratories employed within the CIRI Buildings and Construction span from analysis of the materials to multimedia for 3D modelling and rendering. The purpose of the R&R Unit is the definition of restoration and valorisation intervention procedures on the archaeological and architectural heritage, historic-artistic heritage, buildings and sites, as well as on the environment in which they are placed. Such procedures aim to:

i) establish the parameters for historical and art history analysis, assessing the state of conservation and the opportunity for a conservative intervention;

ii) Define a diagnostic protocol which adjusts to the needs of the artefacts and the environment.

III. A CASE STUDY: THE PIAZZETTA DEGLI ARIANI IN RAVENNA

During the reign of Theodoric in Ravenna (493-526) a wide building ensemble was built in the centre of the town in order to house the Cathedral, the baptistery and the Bishop’s palace of the local Arian cult. The buildings were converted to Orthodox cult after the conquest of Ravenna (540 AD) by the Eastern Roman army (or ‘Byzantines’) [2].

The area known today as the "Piazzetta degli Ariani" (Square of the Arians) preserves the remains of these buildings after about 1,500 years of historical upheavals and misfortunes: the basilica of the Holy Spirit (Fig. 1) [3], the Arian baptistery [4], and ‘Droctulf’s Wall’ (Fig. 2) [5] [6].

Throughout years the buildings of the square have been modified, rebuilt, widened, partly demolished; especially during the 19th and early 20th centuries, the Piazzetta was subject to several attempts to establish trade fairs, water wells, gas stations, parking lots, shopping areas.

The Square of the Arians, whose baptistery is part of the Unesco World Heritage list, is a unique site which deserves to be known, enjoyed and respected: the CIRI Buildings and Constructions, Recovery and Restoration unit aims to set an adequate architectural, physical and cultural arrangement, by stressing the history and historic-artistic value of the monuments on the square.

The R&R unit has therefore led to a feasibility study for the redevelopment of the Square area, based on a structured, multi-disciplinary plan on intervention: the main issues to be addressed are physical and chemical degradation of the structures, social and cultural neglect. The redevelopment project includes different types of intervention, designed to:

- Preserve the structures, aiming to reduce and contain environmental degradation on structures and materials;
- Restore a set of architectural conditions as close as possible to the original;
- Underline the cultural and historical relevance of a unique site in Europe;
- Develop a urban intervention plan which takes into account the multiplicity of public and private properties surrounding the Square.

The work project began with the historic research aiming to reconstruct the diachronic history and changes of the individual monuments over time. At the same time, a graphic and topographic survey of the square and its buildings through photographic capture and a subsequent orthorectification process, also by means of a laser scanner, was carried out. Historical documentation served as a basis for three-dimensional modelling of several main architectural diachronic phases of the complex [7].

The use of computer graphics and photomodelling [8] [9] made possible the virtual reconstruct of four different phases:

- The original phase of the early 6th century: the Arian complex (cathedral, baptistery, Bishop’s palace) was entirely reconstructed.
- An 8th - 11th -century phase: the church and the baptistery, now Orthodox-converted buildings, were joined by a monastery (Fig. 3).
- A 16th -century phase: the portico of the church was demolished and rebuilt; various changes were applied to the baptistery as well.

Fig. 1. Ravenna, Square of the Arians: basilica of the Holy Spirit and ‘Droctulf’s Wall’.

Fig. 2. Ravenna, Square of the Arians: “Droctulf’s Wall” and the baptistery of the Arians.

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A 17th-century phase: the baptistery was combined with an oratory, and heavily modified according to a ‘Baroque’ style (Fig. 4).

Computer graphics had a double role: it has been used both as a means of transmission of the final results, due to its high communicative potential and as a research tool [10].

Reconstructive hypothesis to explain the development of the different historical phases have in fact been elaborated both by traditional research and a visual point-to-point control on various 3D models updated on subsequent working sessions. Moreover, 3D renders for each reconstructed phase have formed a colour-coded map employed to clearly state the kind of documentation behind each 3D model: archaeological evidence, historical documentation, or just conjectures through comparison with comparable structures of the same age.

The analysis of materials and of the decay was carried out through both invasive and non-invasive approaches. The main non-destructive investigations were primarily carried out through Thermographic analysis, used to identify homogeneous masonry and GPR (Ground Penetrating Radar) to detect the presence of damaging moisture.

Micro-samples of bricks and mortars were acquired in order to determine the originality of the masonry (Fig. 5). Such samples were later scanned through X-ray Crystallography (XRD), observations with polarizing microscope for Mineralogy (POL-MO), Thermo-differential and Thermogravimetric thermal analysis (DTA-TG).

The cultural and physical improvement strategies developed to endorse the Square of the Arians of Ravenna and of its monuments, as well as the materials and the results of the study, have been presented in an open-air exhibition entitled "ArianInPiazza", which took place in the second half of July 2013 in the Square itself. All information contents have been made available through varied means: 24 traditional posters explaining various issues (historical context, the Arian cult, the various architectural phases of the monuments), arranged in a ‘tunnel’ framework; documentary videos projected on the walls of the basilica of the Holy Spirit; circular ‘cylinder’ structures designed to show a 360° reconstructive view of three different historical phases of the Square; interactive multimedia contents through QR codes (based on the QR4Cult platform), mobile Apps, a dedicated internet website composed of a net of linked data and thematic tabs: all these tools allowed visitors to experience a virtual reality and augmented reality reconstruction of all four main phases of the monuments along with their respective informational contents [11].

IV. CONCLUSIONS

The work on the Square of the Arians and the associated exhibition were aimed to show how a concerted research action on cultural heritage allows to rebuild lost areas and monuments. The main objective has been to introduce the citizens a new way of enjoyment and understanding the monuments: ArianInPiazza proves how advanced results in the research on cultural heritage are not necessarily confined in academic fields or within classrooms and libraries, but rather they may be available to the community [12].

Every research activity has a potential and concrete interdisciplinary aim. Limited knowledge within strict boundaries of each discipline tends to depress it and restrict its results [13] [14].

The study of cultural heritage has a peculiar status [15]: it is not yet a proper scientific discipline, nor even a science, but rather a borderline know-how whose methodologies and objects are becoming increasingly clear. It is a sort of meta-discipline: a type of knowledge aiming to arrange, model, convey other knowledge and expertise. Such meta-discipline may concern any object by reducing it to a document, that is an information framework, a web of semantic and syntactic relations with other objects and documents. Research activity defines its wide borders, builds and studies conceptual kinds
of knowledge representation, manages information on tangible and intangible documents on cultural heritage. Its keywords are production, managing, preservation, retrieval. Our study has aimed to find out a shared study methodology of cultural heritage, within which different skills and fields of knowledge could work together. We believe it is possible to achieve results which are easily accessible to non-qualified users, without jeopardizing their scientifically-grounded value for the scientific community.

The methodology employed on the Square represents the basis for the development of operational procedures based on multidisciplinary investigations on historic architectural heritage.

Several procedures and results from this case-study are currently available online within an open-access CMS (Content Management System) based website [7]. The website features a multi-user access, allowing different users various degrees of action and responsibility in uploading and editing data: this way information may be both in depth and, at the same time, reviewed and controlled.

REFERENCES


Fig. 6. Micro-sampling of bricks (red) and mortars (yellow) from the “Droctulf’s Wall”.