Computer grafics and preservation of brazilian cultural and architectural heritage

Tirello, Regina A. */ Cultural Preservation Center of São Paulo University (CPC-USP), Brazil College of Engineering, Architecture and Urbanism of the State University of Campinas (FEC/DAC-UNICAMP), Brazil.* **/ *rtirello@usp.br, rtirello@fec.unicamp.br.***

Abstract *This work presents a documenting method for historical buildings which uses the multimedia technology for scientific cataloguing of morphological and environmental transformations of ancient Brazilian constructions aiming a public communication. The computer model proposed here is based on detailed historical studies and prospective archeological analysis of building and artistic material which, throughout the years, are added to old buildings, changing their original shape and environment. Essentially interdisciplinary, this scientific analysis system count on the participation of researches from different subject areas and architecture and arts undergraduates.*

Introduction Computer graphics and historic heritage. Pertinences?

The use of computer graphics related to historic heritage usually takes us almost immediately to the idea of "virtual restoration", a relatively recent concept about which there is no consensus; on the contrary, it´s a debatable issue.

Some people reckon that this expression simply indicates the use of computer tools to perform "perfect" recompositions of buildings, environments, and even of entire ancient cities, using as reference for these virtual reconstructions a repertoire of forms that is already coded. In this logic, any part lacking in a building can be totally reestablished through the use of the typological grammar of the period in which it is inserted. These operations are generally processed based on a modular structure to which one can add elements and ornaments of Classical, Renaissance or Baroque inspiration. In the end, it is possible to "reconstitute" the image of a supposed original status of a given architecture. In recent years, we have been watching the multiplication of CAVES, immersive scenarios and even of typified models, interactive or not, which propose to transport the observer to another time. But what time is this? What historical information do these virtually (and effectively) reconstructed objects manifest? As far as the teaching of the history of architecture and/or broader heritage education are concerned, can these "scenarios of ancient times" – which often resemble a big game – be also a place for learning?

Traditionally, the study of architectural heritage is carried out by means of written documents, photographs, drawings, architectural surveys structured through the use of specific methodologies, so as to guarantee the greatest level of documental rigor in records, without "creativities" and alterations of the sources, which in the area of conservation and restoration would mean to create false histories.

The suspicion of preservation specialists regarding the employment of digital supports for the precise representation of historic architectures is partly justified, among other factors, by the increasing tendency to use electronic means to present obscure "revitalization projects" that have great commercial appeal. As these projects are often committed neither to precise documental historical records nor to authenticity issues pertinent to the preservation of cultural assets, they have little or no concern for the correct geometric and georeferenced representation. The modeling usually results in simulacra of ancient architectures which do not contribute to the amplification of knowledge about past constructions.

Even though it is possible to say that the professionals who work in the preservation area are against the

exaggeration of it, they do not deny the importance of the new media as a useful support to the study, record and dissemination of information regarding cultural assets. They consider that "virtual restoration" may become a qualified field of analysis of objects of the past, provided that they are adequately delimited by written documents and materials. Its conception would have legitimacy if it were based on multidisciplinary research and on critical evaluations concerning the quality of the forms and historical contents expressed in and by the cultural assets that one wants to represent.

The precision required in cultural heritage documentation with multimedia systems, its limits and possibilities are, in fact, important issues to be discussed and analyzed in order to enhance interdisciplinary practices and collaborations. It is undeniable that, to architecture, computer graphics can enable integrated records of quantitative, qualitative and geographic data, provided by the use of CAD systems for free-form surfaces, Geographic Information Systems (GIS) and multimedia. It all depends on how they are made and with what purpose.

The processes to adequate the environment of 3D multimedia records to the conservation criteria can (and should) format new approaches, taking into account not only the technological contents, but also the historiographical ones. This is affected, we believe, by the clarity of the global purposes and by the target audience.

Premises and objectives In the works presented here, we adopted research instruments that are pertinent to the "archeology of architecture", a new disciplinary area that proposes studies of ancient architectures structured on the analysis of wall stratigraphy (explored in many directions) and on micro-analytical investigations that cause little damage to the buildings.

The use of this system enables evaluations of plural sequences of the objects, which went much beyond the simple recognition of construction typologies. It also enables the reading and interpretation of the functions and meanings of the materials and forms identified in the ancient buildings in their diverse stages of physical integrity, a common condition in ancient architectures (TIRELLO, 2006).

This kind of investigation is very efficient to decode and organize diachronically the construction complexity of ancient buildings. Thus, the purpose of the category of electronic record proposed in this work is to combine the traditional process of investigation and documentation of historical heritage with applications of several interfaces.

General objectives: Development of studies and systems for the record and representation of results of works of "surface archeological prospecting", for the relative dating of the construction and ornamental stages of historical buildings.

Specific objectives:

• To establish comparative criteria to analyze, contemporarily, temporal indicators of diverse natures.

• To organize graphical syntheses of the specificities and perimeters of each virtual stratigraphical unit using three-dimensionality.

• To facilitate the understanding of all the evolutional stages of the old buildings as a support for projects of professionals who work in the preservation area with different backgrounds (architects, engineers, historians, restorators, archeologists, anthropologists, scientists, among others).

Methodology and development

Given the interdisciplinary nature of research related to the recognition of the transformations undergone by old architectures, in order to show here the three-dimensional result of the interpretative readings of morphology and environment changes of buildings throughout time, we will present two Case Studies:

Case 1: Casa de D. Yayá (a house that is currently the headquarters of the Center for Cultural Preservation (CPC) of the University of São Paulo - USP): A study on morphology and environment changes to construct a computer model (ongoing).

Case 2: Archeology of architecture applied to a brick cottage of the end of the 19th century (ongoing).

These studies have been carried out within the scope of the research project "Archaeometry and Restoration: Documentation Systems for the Record and Stratigraphical Reading of Historic Buildings" of the program "Conservation

and Restoration of Architectural and Integrated Assets" of CPC-USP, involving many students-trainees of Architecture and Arts.

Such studies were developed in stages.

Stage 1: Primordial evaluation of the historic-architectural object (completed)

To read/interpret the architectural and environmental stratigraphies of the two buildings presented here, we were supported by the combined analysis of indirect sources (the conventional historical-documental research) and of direct sources, related to the in-depth analysis of the construction systems and materials that constitute this architecture and works of art.

These direct analyses are especially important for the recognition of the transformations undergone by a construction and/or ornamentation. They generate a set of data that indicate the "matter of the buildings" and, when these data are correlated and guided by historical-formal research and by laboratory research, they enable the outline of safe chronological indicators. They also allow us to recognize the subtractions and/or additions that an architecture underwent during its life, which are rarely recorded in conventional documents. They are safe "temporal indicators".

The evaluations of the object that were used as reference to the presented model were processed by means of the following studies:

a) Study of the constructed structure: the structural system, the work techniques, the type and nature of the original and added construction materials, as well as their dimensional characteristics, texture and color were investigated.

b) Study of the coatings: the nature of the material (loads and aggregates), the material mixture proportion, granulometry, compaction, color and surface finishing were analyzed.

c) Study of the artistic ornaments: the technical and material typology were examined, as well as form of application, texture, reflectance, color, design (when possible), and finishing (TIRELLO, 2006).

To efficiently organize (and communicate) these intertwined information – which derive from the reading of data resulting from so many "temporal indicators" which originate from these three study categories (sometimes, represented by minute fragments of matter) –, a graphical organization was proposed, synthesizing the specificities and perimeters of each one of these "virtual stratigraphical units". Three-dimensionality was adopted, instead of the conventional two-dimensional records.

Stage 2: "Virtual Restoration" (completed) Construction of the computer model for the studied architectures and modeling for the representation of the many "states of originality" of elements integrated to historic buildings. Each one of their different states of physical integrity, identified through examinations, was represented by means of the system described in the previous topics.

The architectural structure and integrated elements that constitute the different environments of each period were included.

Adopted instruments: Drawings, photographs and three-dimensional modeling programs of parametric solids.

Stage 3: Proposition of strategies of qualified dissemination (ongoing) Elaboration and implementation of interdisciplinary projects aiming to foster new forms of acquisition, information and accessibility to the cultural assets, broadening the notions about the memory of the place and public heritage.

Case Studies

Case 1: Computer model of an architecture with complex historic chronology

At D. Yayá's house (currently, the Center for Cultural Preservation of USP), despite the fact that it has already been restored (CENTRO, 2004), the chronology studies were conducted in 2004 within the scope of the Program Conservation and Restoration of Architectural and Integrated Assets of CPC-USP, in this perspective of graphical synthesis of the temporal indicators by means of the use of computers.

From the beginning, the aim was to establish a "referential relative dating" of the present/added/juxtaposed materials in order to reveal the historical-architectural chronology of the house. To achieve this, different temporal indicators were analyzed simultaneously and comparatively by means of measurements, evaluations of the present construction systems and techniques, chromatic and architectural probes, and laboratory analyses of characterization (TIRELLO, 2001).

The result was the recognition of 4 construction stages, related to the house's owners, who promoted considerable alterations to the perimeter and to the architectural and environmental characteristics of the house.

The 'electronic restoration' of this house consisted of the elaboration of high graphic resolution 3D environments, constituting a single 3D interface by means of which it will be possible to access all the multimedia information and associated documentation, related to the 4 construction stages that were identified and to the history of its architectural restoration (which has already been completed) and environmental restoration (ongoing). The recovery of the wall paintings is being performed by students-trainees of the program "Conservation and Restoration of Architectural and Integrated Assets" of CPC-USP.

Case 2: : Archeology of architecture applied to a brick cottage of the end of the 19th century (ongoing)
When the first probes at D. Yayá's House were carried out, a brick cottage dating back to a period before the 1880s was identified in the center of the current building.

The historical research indicate it is the first brick construction of Bela Vista, a popular neighborhood that was formed in the city of São Paulo at the end of the 19th century, organizing colonies of Italian immigrants. Therefore, this construction coincides with the popularization of the manufacture and use of bricks in São Paulo's constructions, whose systematic study contributes to broaden our knowledge of the construction processes and techniques of that period.

To the recognition of its primitive planimetry, location and dimensions of the original spans, we used combined studies of the construction systems, the mode of bricklaying, grouts, and coating mortars, compared

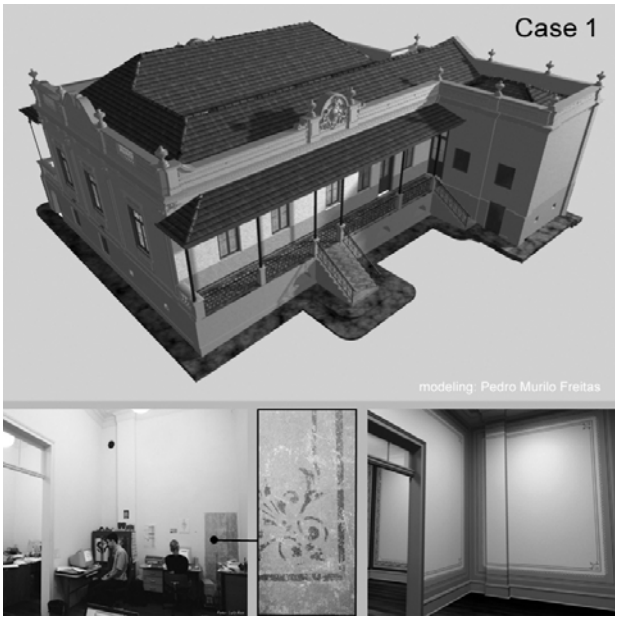

Figure 1 ***Case Study 1.***

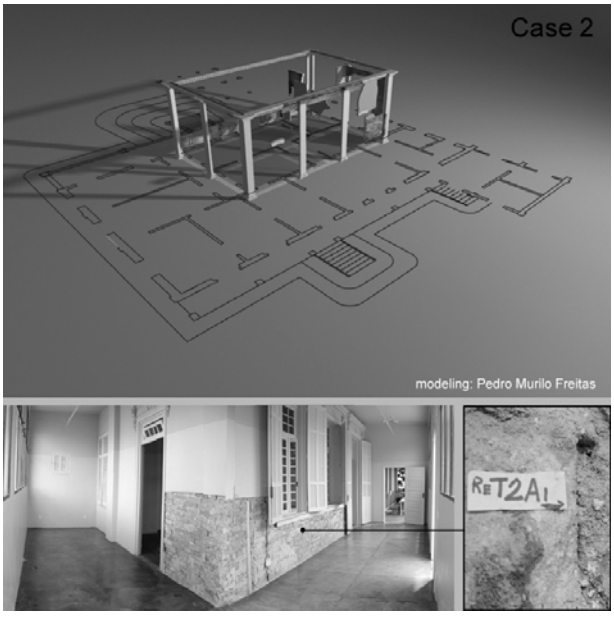

Figure 2 ***Case Study 2.***

with those characteristic of the subsequent reforms of the house.

With these material references, the cottage's perimeter and program was virtually reconstructed. The cottage has been compared with other similar and contemporaneous constructions of the cities of Jundiaí and Campinas, in the state of São Paulo.

Aiming at the public exhibition of these works, a tour guide for two types of public, general and specialized, will be elaborated. It will be programmed in OpenGL, considering scales and points of view which are adequate to the purposes. A 3D interface will be created with other media (video/photographs/audio), and a menu to access the several information levels that we want to communicate will be implemented, supported by two main software:

a) Software with a virtual tour for the public that visits the house, with language that is accessible also to schoolchildren and adolescents.

b) Software with the main technical information about the process of identification and restoration of artistic murals, directed to the specialized public, in the perspective of formation and extension.
The final products will be:

Constitution of a database containing information on traditional construction materials and systems and ornamental models.

Installation of a totem with a screen to exhibit an animated computer model. Through it, the public can tour the house in its four different moments of physical-ornamental integrity.

Final Remarks The proposed 'electronic restoration' is a broad systematization of cognition of an asset and creates new cognitive protocols. It collaborates with the computerizing process of inventories of architectural assets and shows the adequacy of the digital supports as a useful aid to the critical documentation of historic structures, and, consequently, to the judicious documentation of subsidiary projects to preservationist initiatives.

The development and implementation of software that offer an organized historical reading of complex architectural stratigraphies enable a greater cultural dissemination and wide public access to studies of construction techniques, housing programs and the ornamental repertoire of bourgeois architectures in São Paulo, at the end of the 19th and beginning of the 20th centuries.

Acknowledgement FAPESP, CPC-USP and arch. Pedro Murilo G.Freitas (modelling).

References

CENTRO de Preservação Cultural, *Universidade de São Paulo, Casa* de D. Yayá: 2004, Dossiê. CPC-USP, São Paulo. <http://www.usp.br/cpc/v1/imagem/download_arquivo/dossie.pdf>. **/ Tirello, R. A.:** 2001, ***Um trabalho arqueológico:*** A descoberta das pinturas parietais de uma velha casa no Bexiga; in A Casa de D. Yayá. Edusp/IMESP, São Paulo, pp. 101-135. **/ Tirello, R. A.:** 2006, ***A Arqueologia da Arquitetura:*** um modo de entender e conservar edifícios históricos, RevistaCPC, 3, pp. 145-165. <http://www.usp.br/cpc/revistacpc>. **/ Tirello, R. A.:** 2007, ***Analise de cronologias construtivas:*** uma proposição de método de natureza arqueométrica, Revista Brasileira de Arqueometria, Restauração e Conservação, Vol. 1, n. 6, pp. 358–362, AERPA Editora. <http://www.restaurabr.org/arc/arc06pdf/14_ReginaTirello.pdf>.

Keywords *preservation of brasilian architectural heritage, virtual restoration, historical 3D models, Casa de D.Yayá*