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The development of 'Histo-Data-Arq' database of historical buildings of Argentina and other Latin American countries

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ABSTRACT

There is a growing awarenes as to the great significance of monuments and historic buildings as crucial to the "conceptual memory" of many nations in the world. There are already examples of virtual models of such important monuments as the internal spaces of Egyptian Pyramids, the Romanum Forum in Italy, Dresden Cathedral in Germany, etc.

This paper describes a research project that proposes the organizing of a set of "Categories of Architectural Components" arranged in a "hierarchical structure" in order to define a computer methodology for "design and renewal procedures of historic buildings" using a ensemble of "geometrical laws" based on a syntactic structure.

The process shows several sets of historical buildings situated in different regions of Argentina, but could be adapted to other countries such as Brasil, Paraguay and Uruguay (the Mercosur countries), because there are common features in their colonial architecture. It aims at developing systematic knowledge and tools for the efficient repair and maintenance of such buildings, including a graphic and alphanumeric database for the management of the overall process.

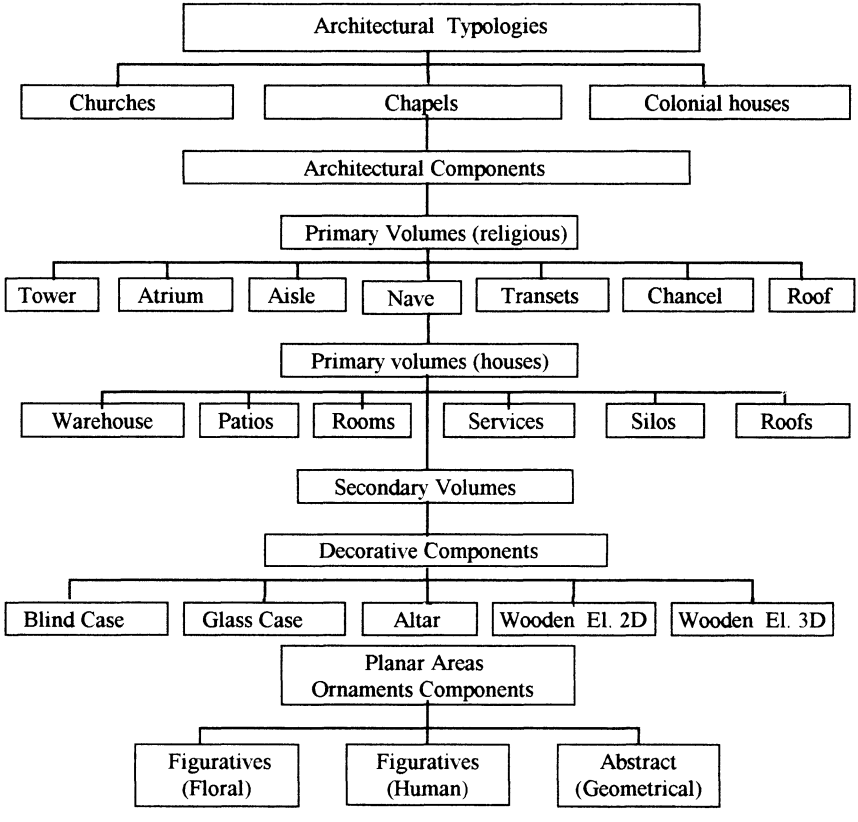
1. INTRODUCTION

In order to conduct the renewal and maintenance of historic buildings a great number of sources are to be consulted such us books, technical documents, antique paintings, photos, etc. . The computer system that can clasp such a variety of graphic and alphanumeric data should take into consideration the technical limits imposed by the use of low cost personal computers.

For the development of a prototype system, the existing colonial chapel of the town of Cochinoca in the Atacama desert in the north-west of Argentina was selected. Also as a first systemic step, a hierarchical classification of architectural components was developed in order to organize not only the

geometrical organization of the system but also the structure of the sources of data.
This classification is based in a set of two groups of buildings, the religious ones and the great colonial houses, both from the XVII century . Figure 1.

Figure 1: Hierarchical classification of architectural components



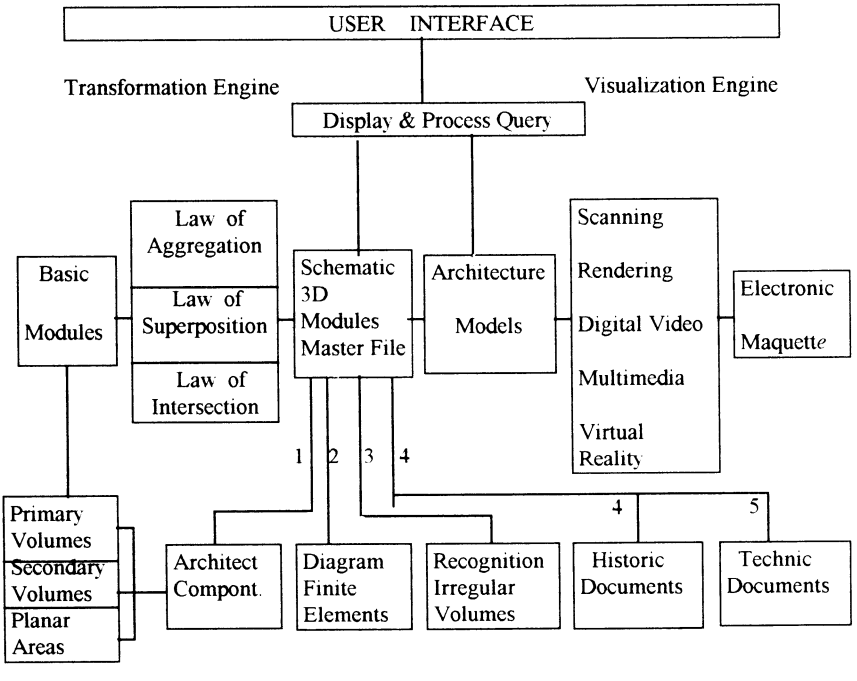
The proposed system will allow the gathering and recording of relevant information useful for architectural and engineering, and numerical models for behavioral analysis. It will also include the history of events related to each building or monument and it will be useful for a knowledge base of repair and maintenance data.
The concept of "virtual spaces" produces a deep change in the models of architectural representation. In the particular case of historic buildings it is important to mention the possibility of developing authentic tridimensional models, instead of the traditional planar view. This allows us to get precise views of those parts of buildings with different types of building pathologies

2. SYSTEM OVERVIEW

This project under development, was prepared to be used by architects, engineers, historians, and different kinds of artists and technicians, in charge of the survey and renewal of historic buildings.

The system avoids the risk of been based in automatic procedures and uses an heuristic approach, based in design methodology routines interfaced with a set of CAD files. The are several phases of procedures according to the type of information to be requested or procesed, as can be seen in the diagram of Figure 2.

Figure 2: Overview of System Architecture



Acquisition And Digitalization Of Data

The first phase use a knowledge base of basic geometric modules as a dynamic 3D generation modeler in order to have as a first step, a design tool to deal with the integration of the architectural components.

The basic modules are digitalized or scanned information from geometric reductions of colonial architectural components. This geometric operation is based on a customized process within the Autocad R12 environment which

enables a set of menus, combining primary and secondary volumes according to the syntax of the geometric laws, applied to the Cochinoca Chapel as can be observed in the screen prints of Figure 3.

Graphic And Alphanumeric Database

As can be seen in Figure 2, the second phase allows to organize a data base with 3D schematic modules. These modules are the basis for organizing a "master file" wich will clasp five main branches comprising the principal computer operations and sources of data of the "Histo-Data-Arq" system.

The difference between the "basic modules"and the "schematic 3D modules" lies on that the first one is only a geometric operation whereas the second one provides graphic and alphanumeric attributes, using ADE, the Autocad Data Extension software for transforming a set of individual drawings into a continuos database.

The first branch indicate the selection of architectural components for analyzing the architectural typology consistency such us churches, chapels and colonial houses. This operations has to be done for the system to recognize each type of building so as to attach to each one the proper components. The main idea is to work with separate 3D spatial components, to attach to the them the data from various sources, and to assemble all the components at the end of the process.

The second branch also includes stress analysis with the finite elements method as a suggested methodology, to deal with serious structural problems that affect many historic buildings. Figure 4 shows an example applied to the tower of the Cochinoca chapel. In this case the DXF files representing the geometrical values from the Autocad menu was exported to the Cosmos system.

Also in the case of ancient buildings with structural deformations due to actions of several types (passage of time, soil weakness, climate conditions, etc.), the third branch will provide an algorithm for the pattern recognition of irregular volumes, by processing measurement data, firstly of the internal walls and secondly of the external walls, as can be seen in Figure 5.

In some cases, depending the size of the building and the conditions of the facade pathologies, it is possible to aquire data from photogrammetry files in order to complete the geometric information of the building. The fourth branch is concerned with a summary of historic documentation based on existing books and documents. The fifth branch is related to such technical matters as building materials and the different types of restoration procedures of artistic elements such as ancient paintings, sculptures, religious objetcs, various types of ornaments, etc..

Visualization Procedures

The fourth phase is concerned with visualization procedures according to several levels of complexity. The first one is based on scanned images of existing data as part of the data base. Figure 6 shows a set of four chapels in the Atacama desert in the North of Argentina. Using also scanned images four colonial houses can be seen in Figure 7, and in Figure 8 the plan of the ancient town of Purmamarca, both in the same region . "Histo-Data-Arq" will include maps and plans of the existing towns for the purpose of placing in these locations the historic buildings and the environmental variables.

While the buildings are part of the database as historic references for consulting procedures scanned images are enough, but when the case of a restoration process, it is neccesary to digitalize all the plans in order to have enough accuracy of the geometric information. This brings a computer strategy that use both, scanned and digitalized images, which is currently under study, because there are some problems of incompatibility of both type of images.

There are other visualization procedures using rendering techniques in order to compare the former state of a building with its conditions after renewal. The evolution of the system from a CAD file to the final stage can be observed in a summarized version shown in Figure 9.

The images in the right column show the differents stages of the design process from the wire frame model to the simulation of differents external and internal views of the Chapel, and the left column show the state of the Chapel before the renewal procedures, and a scanned photo after the renewal, comparing the adjustment of the simulation images with the real ones.

In order to penetrate the spatial complexity of certain building types, and despite the use of low cost PC, the possibility of using a virtual reality simulation process as the Cyberspace Developer Kit (CDK) is under research.

3. COMPUTING ISSUES AND CONCLUSIONS

The system under development tries to indicate a line of research according to the requirements of the sponsoring institutions (*). Architectural historic information can be considered of great complexity from a systemic point of view due to the enormous amount of existing data from different sources. The "Histo-Data-Arq" envisages the possibility to organize a set of files, cheking and combining the availability for computer integration of graphic and alphanumeric data, combining programed routines, and standard format in order to maintain the consistency of the information. The strategy of using low cost personal computers will encourage its difussion in the low income geographical regions under study. The Autocad R12 was adopted because historian researchers along Latin American countries can easily scan or digitalize information from several sources and send it to the CAO Center. This center is currently acting together with the historic research group "Manzana de las Luces", as a pilot center for developing the "Histo-Data-Arq" data base.

For this reason the computing procedures and digitizing routines should be clear and simple.

A short multimedia approach and a digital video of this building showing the features of the system is being developed, as an example of the advantages to work with digitalized information.

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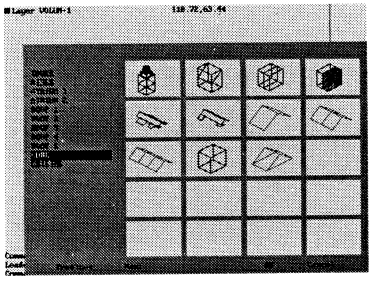
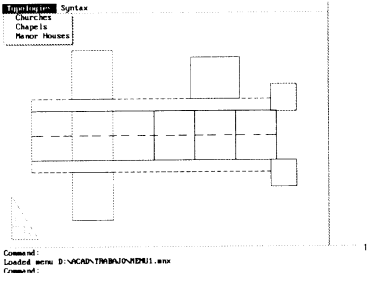
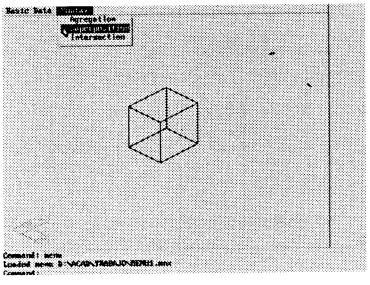
(*) "Histo-Data-Arq" is developed under the aegis of the National Commision of Historic Monuments of Argentina, The International Center for Restoration of Architectural Heritage and the Icomos, the International Council on Monuments and Sites.

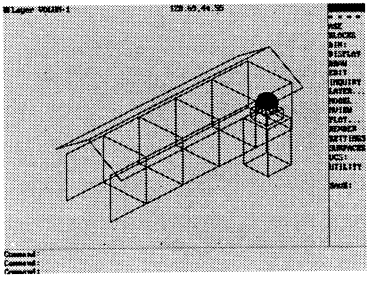
The 'TOPAS' images of Figure 9 were developed by: J.P. Cieri, F. Lazzazera, O. Galdamez

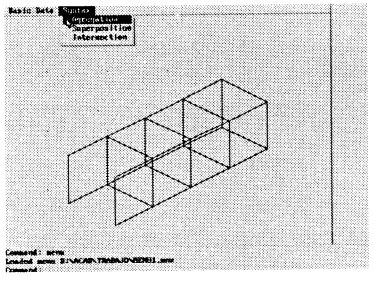
Figure 3: Geometrical operations based in a customized design process using the Autocad R12 enviroment.

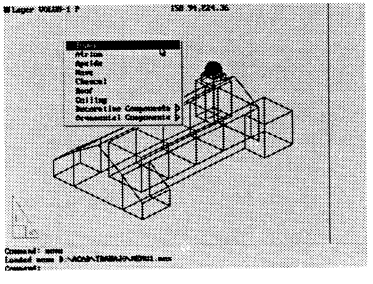












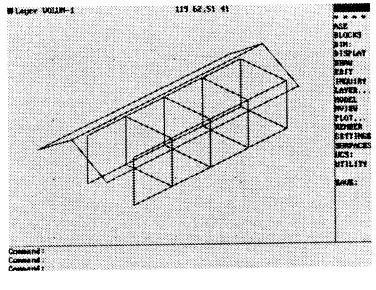


Figure 4: Stress analysis using the method of finite elements applied to the tower of the Cochinoca chapel.

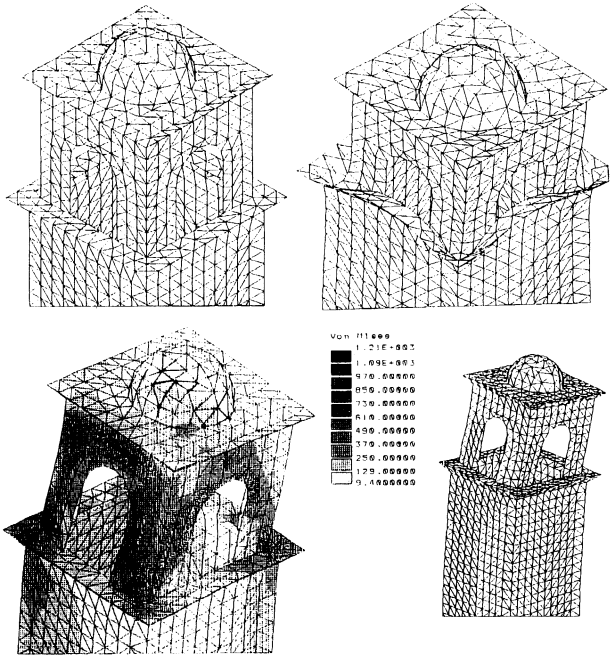


Figure 5:
Recognition of the internal and external walls for precise measurement.

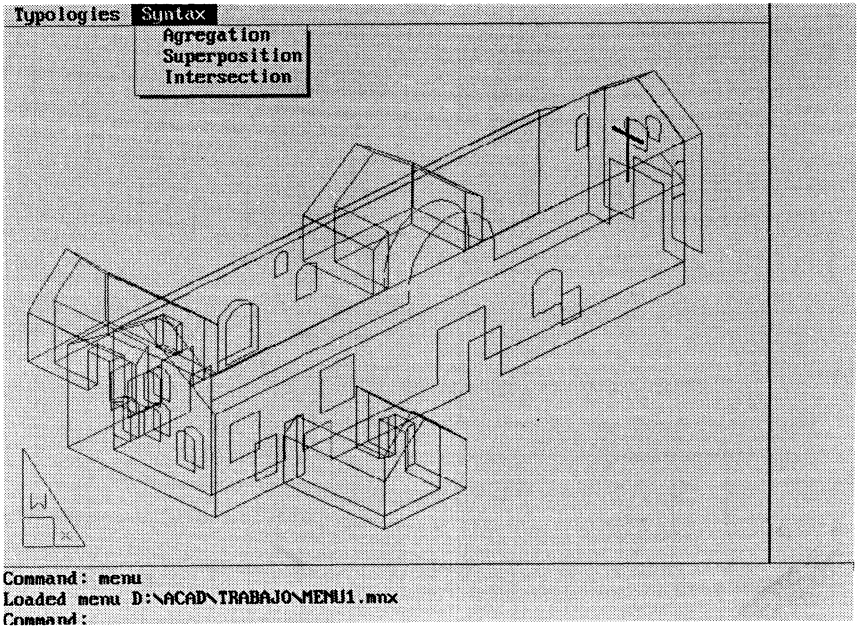
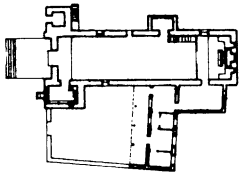
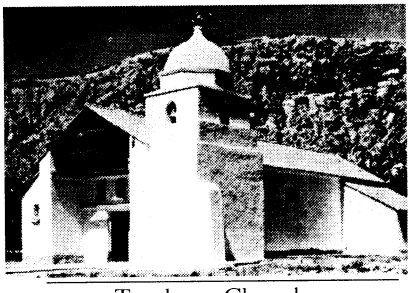


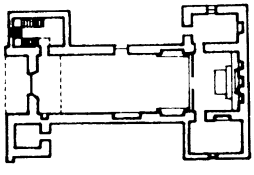
Figure 6: Four chapels in tha Atacama desert. North of Argentina.

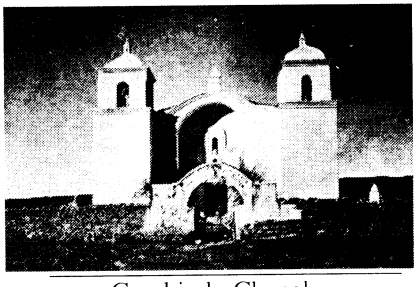
Purmamarca Chapel



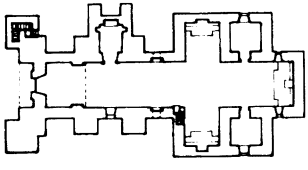


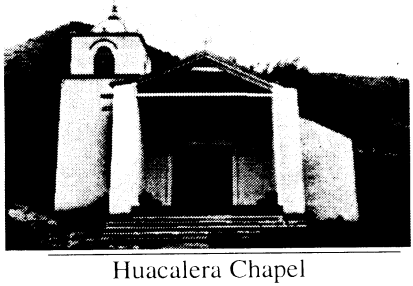
Tumbaya Chapel





Casabindo Chapel





Huacalera Chapel

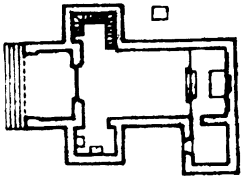
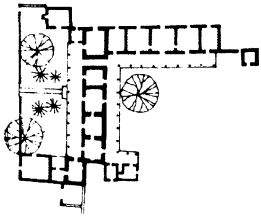
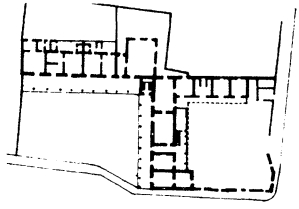


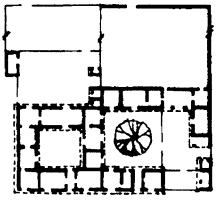
Figure 7: Four colonial houses in the Atacama desert. North of Argentina.



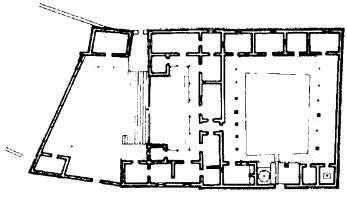
Los Molinos Colonial House



San Pedro Colonial House



Hornillos Colonial House



Tumbaya Colonial House

Figure 8: The ancient town of Purmamarca. North of Argentina, province of Jujuy.

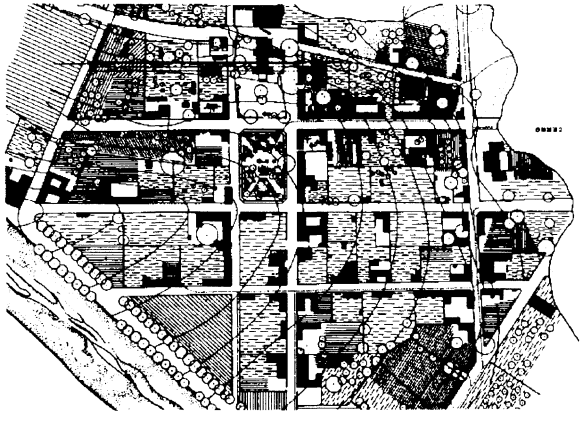
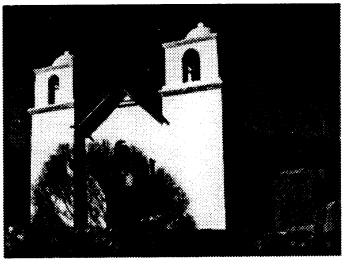


Figure 9: Summarize vision of the system from a CAD file of the Cochinoca chapel.



Our lady of the Candelaria -Cochinoca-