

SURVEY, RESEARCH AND VIRTUAL REALITY IN THE MONUMENTS OF SEVILLE INCLUDED IN THE WORLD HERITAGE LIST

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ABSTRACT

The monumental complex constituted by the Alcazar, the Cathedral and the Archivo de Indias in the city of Seville has been the subject, since its inclusion in the World Heritage List a few years ago, of an extensive documentation project that is to be basis and side work for other research and restoration works carried out. Systematic use of classic photogrammetric processes, forced by the size and characteristics of the monuments themselves, has provided a wide collection of wonderful drawings. Based on this documentation, and on an extensive historic and architectonic research, the analysis of historical transformations in the buildings has been approached, as well as the carrying out of a number of reconstructions using virtual models. With them, some audio-visual montages have been done, explaining the evolution along time of the most significant buildings.

1. INTRODUCTION

In the Southern extreme of the historical city of Seville, enclosed in an area of 15 Ha, the Alcazar, the Cathedral and the Archivo de Indias can be found. All of them were included in the World Heritage List in 1987. This monumental area contains an unique complex of buildings with high artistic, historical and symbolic values that are deserve of international recognition.

The Alcazar dates back to the 10th Century and is the oldest royal still in use palace in Europe. It contains palatine structures from the Almohade period (12th Century) and Christian ones from the 14th Century, with clear Islamic influences. This palace complex suffered from important transformations during Renaissance and Baroque periods, making it a wonderful example of cultural hybridization.

The Cathedral is sited on the old Almohade mosque, of which some important remains have always been visible and many others have been found. Among them is the old minaret, the Giralda, and part of the courtyard, as well as other remains discovered during archaeological excavations that have

provided knowledge of its original shape and size. The original Islamic building was one of the biggest mosques in the Islamic Occident, measuring 135 x 113 m. Converted into Cathedral after the city was conquered by the Christians in 1248, it remained without much alteration until the beginnings of the 15th Century, when the Gothic church was built using the whole site of the former prayer room of the mosque. It is the biggest Gothic cathedral of Europe, being 137 m long and 85 m wide, to which the old courtyard, now cloister, and joined structures must be added, taking up over 20.000 m² in plant.

The Archivo de Indias is a magnificent building that was designed by architect Juan de Herrera in the second half of the 16th Century to be stock exchange and market (Lonja). It was reformed in the 17th Century so that it could host all documentation related to the discovery and colonisation of America. Thus, this building contains a great quantity of invaluable documents not only to Spain, but also to American countries and Philippines.

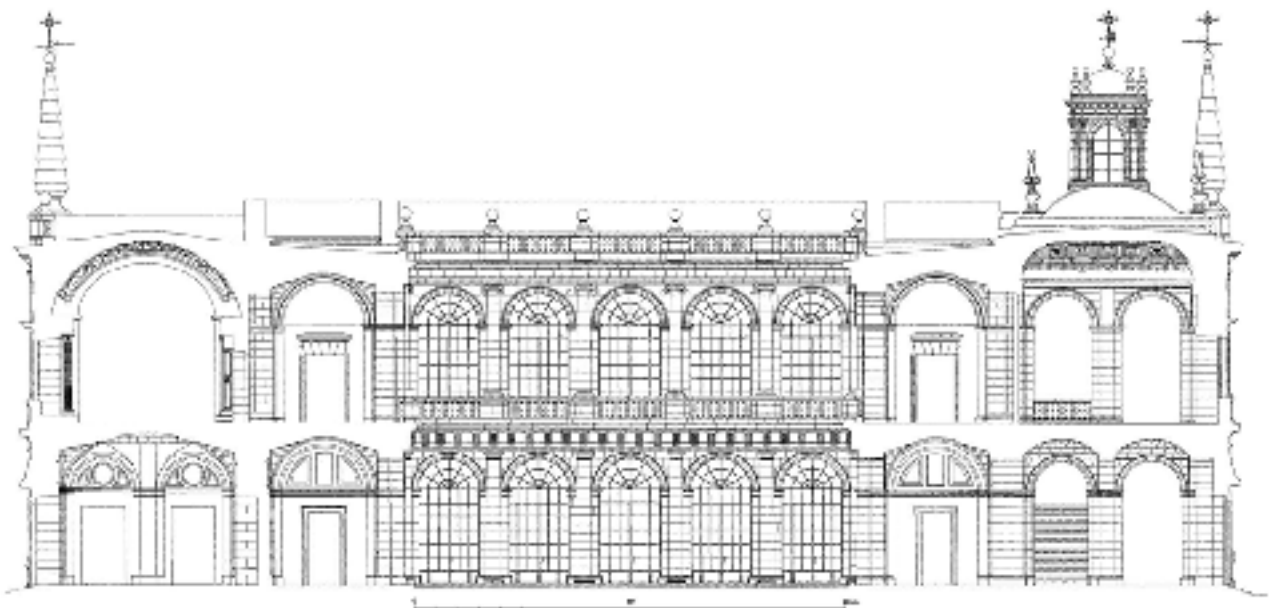


Fig. 1.- Cross section of the Archivo de Indias building.



Fig. 2.- General plan of the area generated by aerial photogrammetry

Also near the Alcazar was the Casa de Contratación, in which all commerce and people-traffic between Spain and the New World in the 16th and 17th Centuries was ruled and controlled, reminding us that Seville became during those centuries the main gateway between Europe and America.

To sum up, in a small area a number of buildings with high historical and artistic value can be found, and of which a very

limited planimetric documentation existed when they were included in the World Heritage List

2. THE SURVEY

From that moment onwards, we have been working on the creation of reliable documentation to be used in future restoring interventions and to better know this monumental complex, both physical and historically. First photogrammetric documentation works were carried out in 1984, when the Giralda, the Cathedral=s bell-tower and former mosque minaret, was surveyed using equipment from the Ministry of Culture (Jiménez, Almagro 1985, Almagro 1988). In 1987, partial surveys of the Lonja building (Fig. 1) and the Renaissance part of the Cathedral complex were carried out. It was also in the course of these years that a number of aerial photographs for the area at a 1/1000 scale were taken. These photographs allowed the survey of the buildings roofs with accuracy enough for architecture plans. In the following years, plans of different monuments= roofs were made, starting with the Cathedral, and later the Alcazar, and then the whole area, which has been a great help when carrying out surveys of the sections of buildings and when putting them in relation to each other and analysing transformations of the area along time.

Since 1994, the School of Arabic Studies (CSIC) has developed a planimetric documentation and research project on the whole complex, joining in the effort different sponsors (Patronage of the Real Alcazar, Cathedral=s Chapter, National Research Plan), in order to produce an exhaustive and reliable survey from the different monumental buildings and carry out research on their historical evolution, using virtual reconstruction techniques to spread the acquired knowledge.

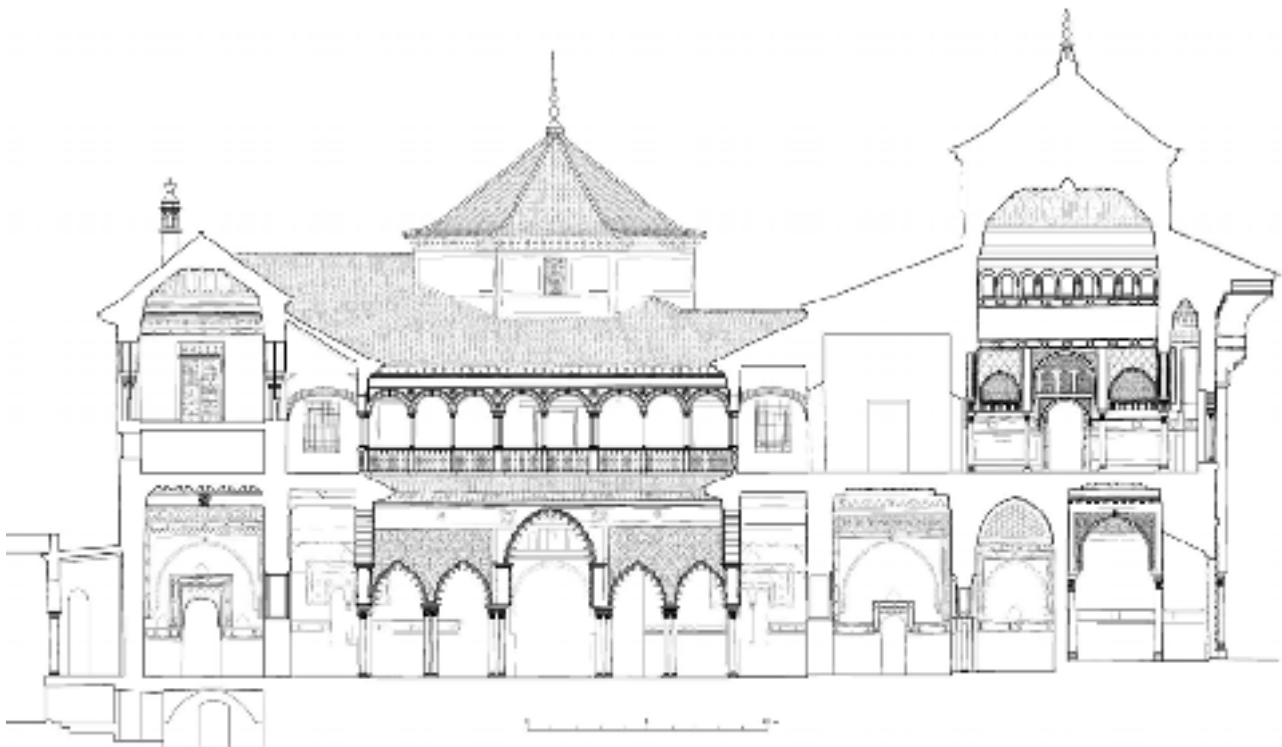


Fig. 3.- Section of the Palace of Peter the 1st, in the Alcazar, through the Patio de las Doncellas.

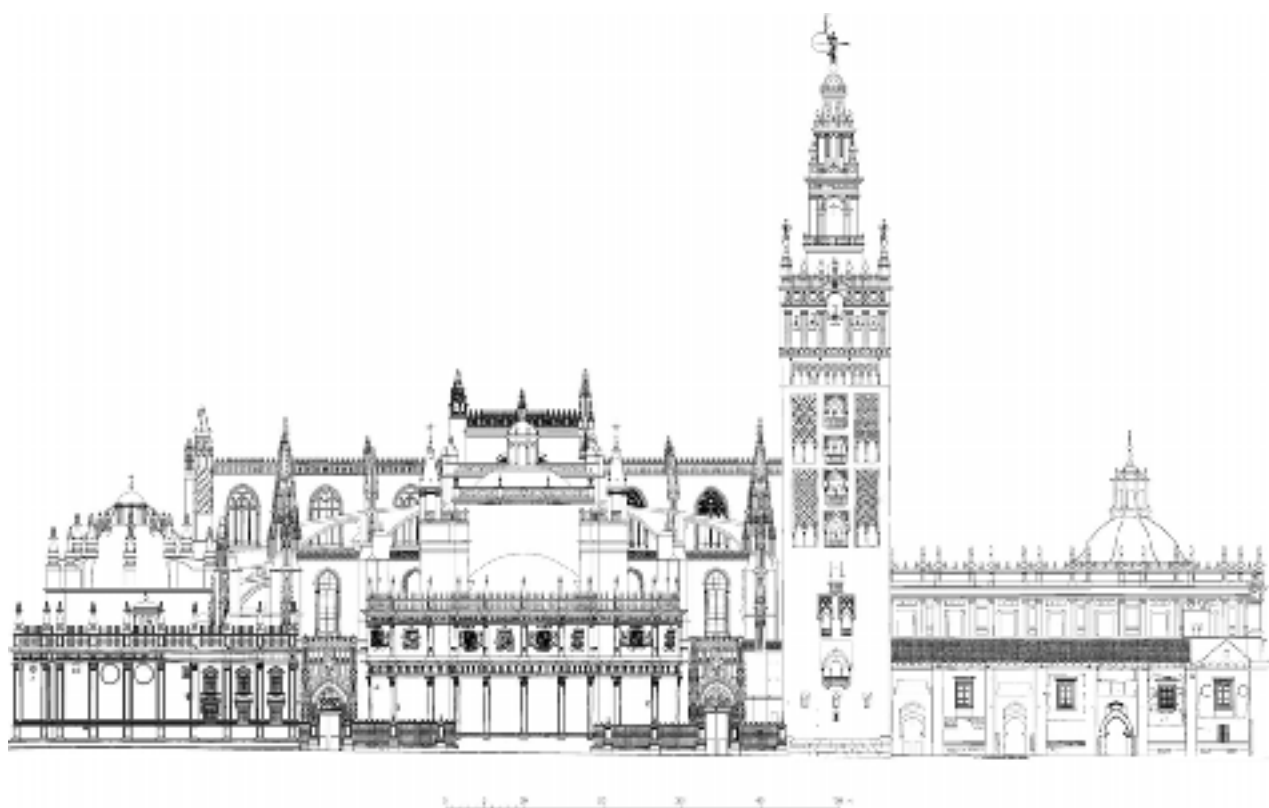


Fig. 4.- East elevation of the Cathedral of Seville. On the right side, remaining parts of the mosque.

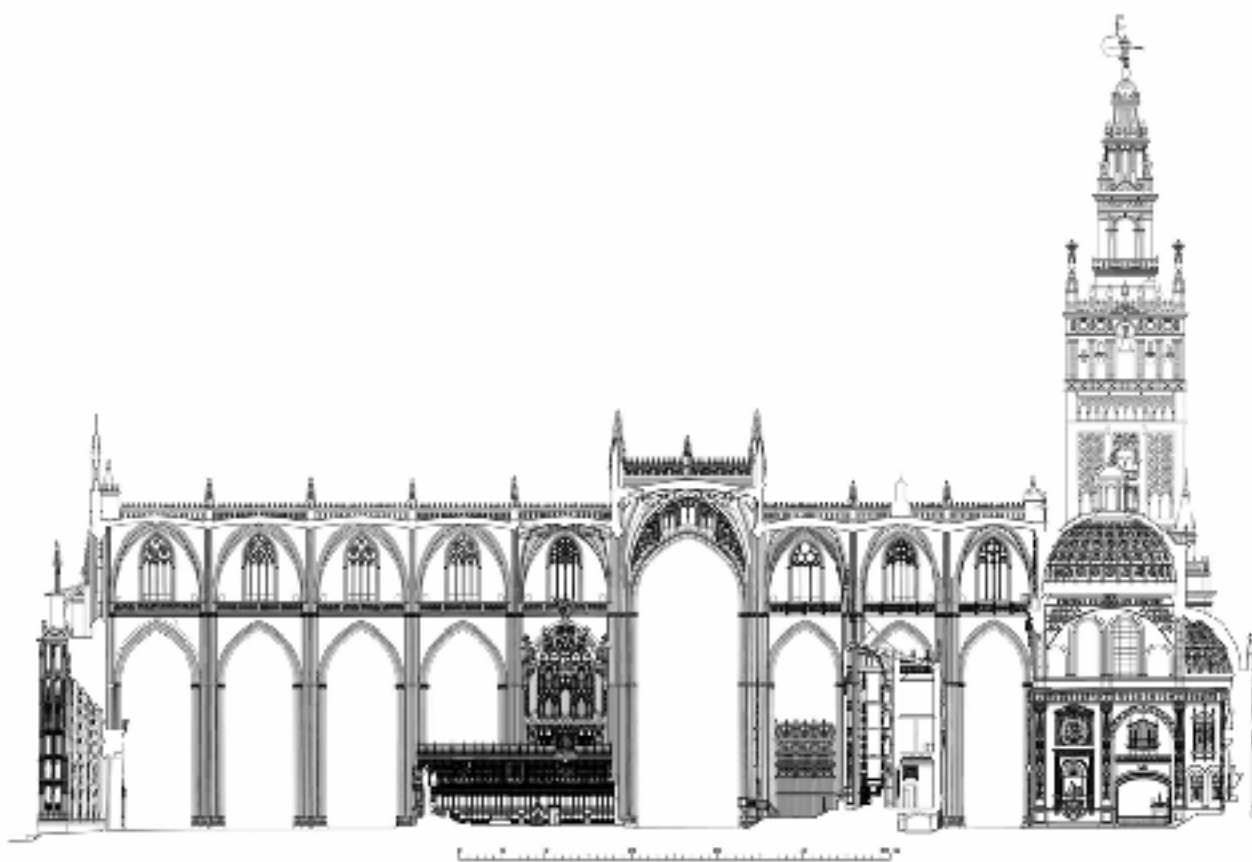


Fig. 5.- Longitudinal section of the Cathedral of Seville.

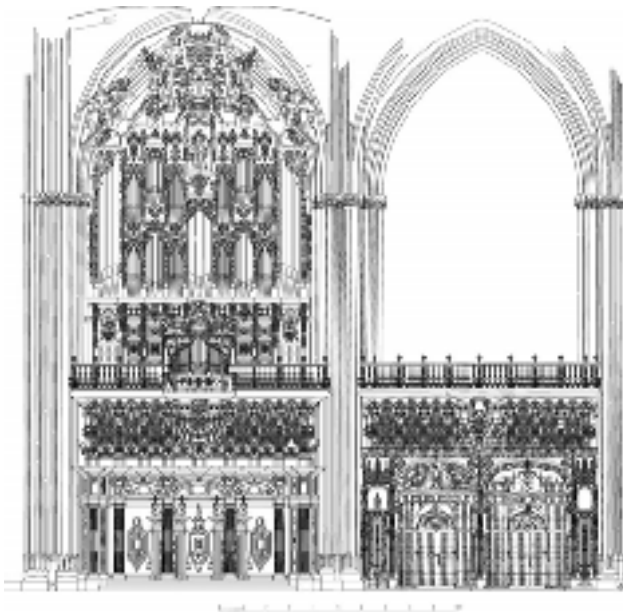


Fig. 6.- Elevation of the organ and choir of the Cathedral.

Firstly, surveys done between 1984 and 1987, were carried out using available equipment from the Ministry of Culture, that is to say, metric cameras and analogue stereo-plotters. Since 1994, semi-metric cameras and analytical stereo-plotters have been used to produce documentation in CAD format. From 1997 to 1999 a complete survey of the Royal Alcazar was carried out, thanks to a number of agreements for scientific collaboration between the Patronage of the Alcazar and the School of Arabic Studies. Before that, a plan of the whole complex had been done, measured using topographic methods, including the creation of a station point system. This task was carried out by Tecnocart, a company from Seville. Furthermore, the School of Arabic Studies had already been developing some documentation works, more specifically roofs=surveys including the whole area between the Cathedral and the Alcazar, using aerial photogrammetry (Fig. 2).

For three campaigns, those from 1997 to 1999, elevations, sections and detail surveys of the different parts of the Alcazar were carried out, mostly using photogrammetric systems. They were considered the most suitable ones for this kind of task, as they can be carried out with barely any auxiliary means (scaffolding, cranes, and so on), take very short field-work time and provide great homogeneity in both accuracy and quantity of information to be included in the drawings. This is specially important in cases such as these, in which decoration shows very special characteristics and importance.

Complexes such as the Patio de las Doncellas (Fig. 3), with its extensive lozenge decorated plaster surfaces, or the Ambassadors' Hall, with its semicircular woodwork cover can difficultly be measured and drawn without the use of photogrammetric technics and computer aided design systems. These systems even allow the creation of tridimensional models that can be visualized from different points of view and at different scales.

Already made plans do not include every Alcazar=s section and elevation, but it is restricted to the most outstanding areas and elements, both architectural and artistically. It allows better knowledge and accurate information of the most important structures, and it can be used as a basis for a possible future development of complementary documentation works that should be linked to ordinary conservation and maintenance works on the monumental complex.

These works have been carried out using the semi-metric Rollei 6006 Metric camera and a Hasselblad SWC that had been converted into a semi-metric one in the School of Arabic Studies (Almagro 1996). To measure control points Wild T1000 and TCR303 theodolites have been used, the later one with a laser distance-metre. Plotting has been done with Leica SD2000 and Adam MPS2 stereo-plotter. For some detailed works a Kodak DC200 calibrated digital camera and VSD digital stereo plotter system from the AGH Krakow University have been used. All drawings have been digitally drawn using AutoCAD. The now nearly finished systematic survey of the Cathedral was started in 1996. Prior to that date, the School of Arabic Studies had carried out the survey of the Almohade mosque=s remains conserved in the Patio de los Naranjos, which had allowed the creation of hypotheses on the original shape of the Islamic building. The survey of the Gothic church was started at the vaults (Almagro 1997:187-188), and was followed both by general elevations and sections (Figs. 4-5) and by the documentation of a number of more detailed parts (Figs. 6-7), chosen in relation to the building=s conservation needs, specially those related to the structure=s stability, and to a number of archaeological excavations. Equipment and methods used were similar to those of the Alcazar, although in certain cases model orientations have been done using bundle adjustment (Almagro 1997).

3. RESEARCH AND DISSEMINATION

Using these plans, a number of research works have approached the shape of these buildings at different moments of their History, expressing the different hypotheses in plans, elevations and sections (Almagro 1999). A further step has been taken by the dissemination of these studies using virtual models and their visualization in images, panoramas or animations.

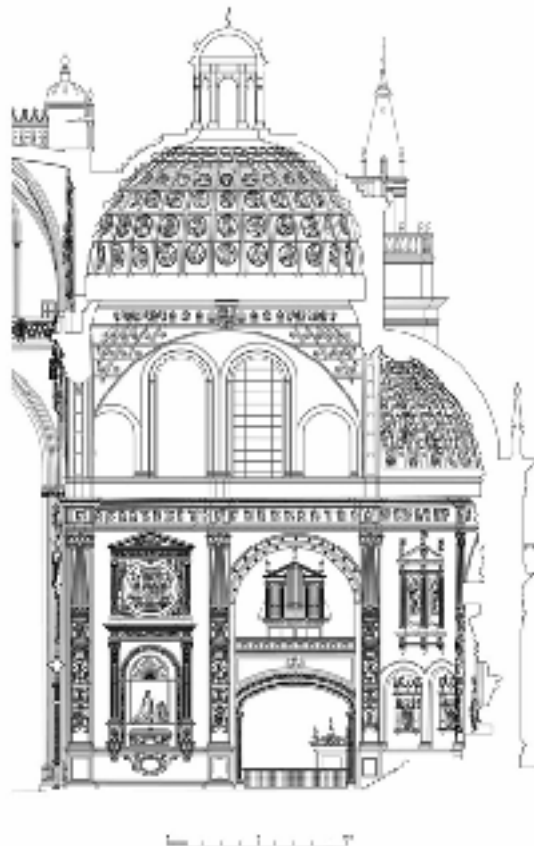


Fig. 7.- Section of the Royal Chapel in the Cathedral.



Fig. 8.- Virtual reconstruction of the Patio del Crucero in Christian times.

Virtual reconstruction instruments have numerous uses that can be considered in two general groups: The first one would be that of making research and reflection on disappeared architectural Heritage easier. Virtual recreations force us to consider represented objects as a whole, to propose solutions for each detail and component, and, using these images, to reflect on our final hypotheses and, therefore, our work. Our experience on this has been very exciting. For over two years now, the School of Arabic Studies research group working on Islamic Architecture has been using these methods when attempting to shape our hypotheses and check conclusions reached as a way to further our research. This process has, in many instances,

made us reconsider hypotheses and approach questions that had not even been put forward before. In certain cases, it has allowed the visualisation of different solutions and discussion on them, not only as hypotheses on the original shape, but also as restoration proposals. These systems permit the avoidance of mistakes that would be difficult, and costly, to correct, as they do not affect the building or object in any way and can therefore be considered as a completely “reversible” methods.

Dissemination of information is another of the many uses of these systems. Doubtless, this is one of the most interesting fields, and the one that can provide most social profitability, up to the point that is not unthinkable that in a near future it can be almost indispensable to use these instruments to dissemination our researches’ results.

However, the development on the use of these systems must have its own research and reflection. We now have instruments unknown of before, and their correct use can provide wonderful results, but an innapropriate use can also generate incorrect products, and, therefore, negative reactions. It must be taken into account that the use of these computer applications is very widely spread among technicians and professionals not related to our studies and who, in answer to social demand for this kind of representations, are logically tempted to provide images that, in many cases, lack adequate scientific support in their creation process. Problems can come either from general conception of the hypotheses, or when trying to give answer to details, such as textures, materials or colours, or in the search of Aphotorealistic@views on which no evidence can be found, and that can create a falsehood feeling in proposals.



Fig. 9.- The Patio de Contratación after the Christian alteration (14th. Century) in a virtual reconstruction.



Fig. 10.- Virtual view of the Patio de Contratación in Almohade times (12th Century).

Our works in this field up to now include the analysis of the successive transformations in the Patio del Crucero in de Alcazar of Seville (Fig. 8). They have finally resulted in the creation of an audiovisual presentation that can be seen by visitors in the monument itself and has also been published in CD-Rom (Almagro 2005b). Studies have also been done prior to the recuperation of the medieval garden in the Patio de las Doncellas (Almagro 2005a). We have also carried out reconstructions of the historical phases of the Patio of the Casa de la Contratación (Fig. 9-10) and the reconstruction of the Almohade Mosque (Figs. 11-12) in animations and panoramas. At this moment, we are working on a reconstruction of the state of the Alcazar as it was in the 14th Century for its presentation in an exhibition that is to be held there next year. Some of the aforementioned works have already been published (Almagro 2000, 2003) and other ones are soon to be.



Fig. 11.- The Courtyard and the minaret of the Almohade mosque of Seville in a virtual view.

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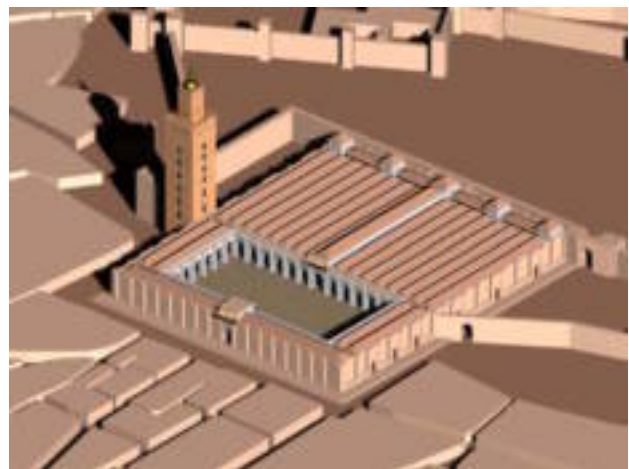


Fig. 12.- Virtual view of the Almohade mosque of Seville.