Aspects of Tenochtitlan:
Nature of CD-ROM Production in the
Construction of Content

Antonieta Rivera
University of British Columbia
arrivera@architecture.ubc.ca

Jerzy Wojtowicz
University of British Columbia
jw@architecture.ubc.ca

At the beginning of the sixteenth century, the Aztec capital, Tenochtitlan, was one of the world's largest cities. By 1521, the Spaniards under Hernán Cortés had destroyed both the Empire and the city. Tenochtitlan was recorded in its foundations and Mexico City was built on top of it (Matos, 1995).

This paper discusses the process for developing digital interpretations of the Templo Mayor and Ceremonial Precinct of Tenochtitlan based on historical, iconographic, and archaeological sources. To this end, digital models were constructed by taking into consideration Aztec archaeo-astronomical principles and测量 systems. The result is an interactive view of the Ceremonial Precinct, perhaps the most comprehensive view Tenochtitlan was destroyed more than 500 years ago. This project has been recently published on CD-ROM.
Introduction
Technical advances have provided architects, art, and architectural historians with opportunities to acquire a far better understanding of the design processes underlying an historical site. The link between the art historical method and architecture is more effective if the researcher has been trained as an architect who understands the theory and practice associated with designing and building. Furthermore, with the advances in computer technology, it is now possible to be much more objective about the physical evidence of historical sites and to test theories more rigorously and consistently. Sparse historical data such as drawings, contemporary descriptions, written theory, and precedent can be incorporated to the physical evidence. Incomplete or radically altered historic sites can be studied in considerable detail and reconstructed in digital space (Tavernor, 1995). This paper describes the development of an interactive view of Tenochtitlan.

The first descriptions of Tenochtitlan go back to the descriptions of the Conquistadors and the chronicles of the missionaries written and illustrated in the 16th century. According to these sources, Tenochtitlan was considered the center of the political and religious power of the Aztec empire. This was probably the reason why it was razed by the Conquistadors. The new city was built over it, symbolizing the new order.

Since its burial, there have been several attempts to reconstruct the ceremonial precinct of Tenochtitlan, and different interpretations have been made particularly of the main temple or Templo Mayor. A corner of the 'Templo Mayor' was excavated and left open to visitors after the sewer line was put through at the turn of the 19th century. But it was only a decade ago that the remains of the Templo Mayor of Tenochtitlan were fully uncovered, along with investigations of other portions of the Ceremonial Precinct.

The objective of this research project was to analyze different sources and generate digital interpretations of this ceremonial precinct. These sources included: the eyewitness accounts by the Conquistadors; the chronicles compiled by the missionaries; the schematic representations of the temples in several native codices; surviving Aztec temples; and the archaeological excavations.

The methodology for developing these digital interpretations involved extensive analysis of the variety of sources. The construction of digital models of architectural elements of the precinct was essential in isolating and verifying geometrical and astronomical alignments of the archaeological findings. The incorporation of the research findings and the process into a multimedia format afforded a multiplicity of interpretations. The development of a CD-ROM is discussed using case study method (Figure 1).

the construction of content
The process of content development in this project was greatly dependent and facilitated by the employment of new media. During the research and analysis stage, a database of texts and images was constructed. This database
proved to be an invaluable source of information in the process of elaboration of the computer models, since it was constantly referred to in terms of dimensions, proportions, materials, etc.

The computational tools in the geometrical exploration stage became of particular importance considering its capability of working with large amounts of information in the same digital space. Deep geometric structures and an underlying system of regulating lines were isolated during the modeling process. (Figure 2) A complex geometric structure was discovered not only in the shape of the ‘Templo Mayor’, but also in the stages that lay underneath. These stages were carefully built following these lines and proportions. Even a reconstruction of the unknown first stage was attempted, and a new relation was discovered between this and the final stage. This could be of particular importance if a connection is made with other aspects in religion and astronomy. This geometrical order can also contribute to future interpretations of Aztec architecture.

The last stage involved reconstruction of the architectural elements of the Ceremonial Precinct. (Figure 3) A vocabulary of form was developed and each element was isolated and explored, this being possible only with these computational tools. The ability to manipulate and modify the objects in digital space was of extraordinary significance since several possibilities could be explored as opposed to a conventional clay model. (Figure 4)

the development of the interactive design

This research project was particularly suited to be built in a multimedia format due to:

The audience, either public or not familiar with Aztec culture and architecture or researchers from other disciplines—archaeology, education, history, etc.

—The need for contextual references in order to understand the architectural elements,

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these include cultural and historical aspects.

— The different sources that generate different interpretations of the same corpus.
— The nature of the computational tools in the process.

The design of the multimedia visualization was developed in three independent design levels: the conceptual design level that specified the goals, the content, and the structure of the application; the interactive design level that specified how users would affect and would be affected by the application, and how their interaction will support the underlying application metaphors; and the visual design level that specified the actual appearance of the application. (Figure 5)

In the conceptual design level, the structure of the application was divided into six layers of information: An “Introduction,” a “Cultural Background,” a “Scientific Background,” the “Digital Interpretations,” a “Bibliography,” and “Glossaries.”

The “Introduction” explained the project and its interactive research approach. Nevertheless, it was clear that a cultural background was necessary in order to understand the interpretations. Therefore a section on “The History and Culture of the Aztecs” was included in order...
to explain Aztec cultural aspects relevant to architecture:

- The setting—the geographical location of Mexico and the Valley of Mexico. (Figure 6)
- The city—the layout of Tenochtitlan and the Ceremonial Precinct.
- The culture—the history, religion and society of the Aztecs. (Figure 7)
- The sources—the sources that were analyzed for the interpretations: the Aztec Codices, the accounts written by the Conquistadors, the chronicles compiled by the missionaries, and the archaeological records. (Figure 8)

“The History and Culture of the Aztecs” provided a cultural background but a scientific background was also necessary to explain the archaeoastronomical principles used to model the architectural edifices. These concepts were fundamental for defining not only the location of the architectural edifices in a physical and astronomical landscape, but also for determining its shape and proportions. Hence, a section on “The Role of Archaeoastronomy in Architecture” was covered, and concepts of positional astronomy employed in ancient Mesoamerican architecture were defined in (Figure 9):

Figure 6: A view of the three dimensional model of the Valley of Mexico in the cultural background layer.

Figure 7: The festivals performed in honor of the gods within the Ceremonial Precinct depicted in Sahagun’s “Primeros Memoriales.”

Figure 8: The archaeological excavations of the “Templo Mayor.”

Figure 9: The archaeoastronomy adenaus in which the texts are drawings of the astronomical observations recorded in the Florentine Codex.”
—Antecedents—the union of space and time in Mesoamerican cosmology, the planning and orientation of ceremonial centers, and the reference points in mass and open space.

—Astronomical events viewed from the Great Temple of Tenochtitlan—the solstices and equinoxes.

—Orientations used in Tenochtitlan—the true North-South, the magnetic North, and the symbolic importance of 88 degrees East of North. (Figure 10)

In “The Digital Interpretations” section the user has the option of exploring the ceremonial precinct in two ways:

—By Source—The original image, text, or archaeological record was incorporated into this section as well its digital interpretation. (Figure 11)

—By Architectural Element—A description of each edifice and its geometrical and astronomical analysis was included. (Figure 12)

These options allow the user to interactively understand the interpretations according to his knowledge and interest in Aztec architecture.

Particular care was taken for the “Bibliography” considering the nature of the multimedia format. It was not a conventional bibliogra-
phy, since it covered a database of books, images, animations, and sounds. (Figure 5)

"Glossaries" were included, since they could help the user to understand terms, chronology and ceremonies of the Aztecs. Special attention was given to the credits, since many people helped the author to carry out this complex research project that involved archaeology, architecture, astronomy, computer science, and history. (Figure 6)

In the interactive design level, the Aztec conception of the universe divided into layers was chosen as the underlying metaphor in which the user would explore the multimedia visualization. The user can go through the project in a linear way, going from general aspects to very particular ones, or move in a non-linear way, exploring aspects of the user's particular interest. The underlying metaphor is subtly present in the user's movement within the different layers of exploration.

In the visual design level, the 'Codex Vaticanus' image (fols. 14v-17r) that depicts the layers of the Heavens, the Earth, and the Underworld was selected as the basis for the visual design concept. In this image, a series of horizontal bars represent such layers. The design concept was to transfer this image to the digital

Figures 5a, 5b, and 5c. The Ceremonial Precinct according to different sources.

Figure 5. Each historical image is credited with its own source as well as in the 'images' database.
format, that had certain restraints related to its dimensions (640 by 480 pixels) and proportions (3:4). A series of horizontal rectangles arranged in a vertical axis are the elements of the interface in which the user interacts. These elements always have the same location in the computer screen, but their colour changes according to the "depth" of the user's exploration. The colours— an earthy red, a vivid blue, and a white-wash gray— were chosen from the pigments that still remain in the archaeological sites.

Finally, the image of the underlying geometric structure of the Great Temple was used as a subtle background. All these graphic elements helped create a continuity throughout the interactive application.

the contributions of interactive research in the development of content

The major contributions of this interactive research were:

— An exploration of the technical and intellectual issues associated with building virtual representations of historical sites.
— A demonstration of the potential for applying interactive technology to multidisciplinary research project.

— A comprehensive understanding of an archaeological site.
— The development of new approaches to academic research as well as the dissemination of findings.

The results of this multimedia interactive project were of value to a wide range of disciplines, since it not only offered a unique and comprehensive interpretation of the Ceremonial Precinct of Tenochtitlan since its destruction more than 500 years ago, but it also demonstrated and recorded the critical application of information technology in an interdisciplinary research project.

computational tools

Although several computer tools were employed during the development of the cassowary, the Macintosh and the Silicon Graphics environment were the ones used more extensively. The project was developed in a Macintosh 8600 and a Silicon Graphics Indy workstation. The Macintosh environment was used for image, sound, and video processing as well as the multimedia authoring. The three-dimensional models were rendered and animated in the SGI environment.

The software used for image, sound, and video processing were Adobe Photoshop, SoundEdit, and Adobe Premiere respectively. Alias Wavefront was used for rendering and animation.
references


