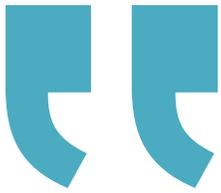


Intergraph® Software Used to Reconstruct Ruins



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The city of Gallup, in northwestern New Mexico, United States, is a center for contemporary Native American culture and county seat for McKinley County. Throughout the area, there are countless remnants of a pre-Columbian culture known as the Anasazi, which occupied the Four Corners region from approximately 300 to 1300 CE. With the aid of geographic imaging technology, local scientists are bringing the ruins of buildings abandoned by the Anasazi centuries ago back to life through virtual reality. For several years, McKinley County GIS Center has been working with the Navajo Nation Historic Preservation Department and Chaco Culture National Historic Park to document and create virtual reconstructions of these ruins and their surrounding landscapes. One project of particular historical interest is the reconstruction of Pueblo Bonito, a preeminent building at the center of the Chaco Complex in Chaco Culture National Historical Park.



The objective of the Pueblo Bonito project is to initiate an informed, long-term management strategy of the site that serves the preservation, protection, research, interpretation, and Native American communities equally.

Built on the floor of Chaco Canyon beneath the towering sandstone cliffs of the canyon walls, Pueblo Bonito has a complex construction and use history spanning half a millennium, from the opening of the ninth century CE to the close of the thirteenth century. In its final form, Pueblo Bonito contained over 350 rectangular rooms, some of which stood four stories tall (50 to 60 feet), approximately 50 ceremonial chambers called kivas, and adobe-paved platforms and roadways. The entire complex, encompassing more than ten acres, is recognized as the greatest pre-Columbian architectural achievement in the American Southwest.

Creating a virtual reconstruction of such an immense, complex structure, and modeling what the terrain would have looked like 700 years ago, is a daunting task. Over the centuries, the elements — and gravity — have been less than kind to Pueblo Bonito, reducing many of the massive walls to mounds of rubble. As if time and the elements had not done enough, in 1941, Threatening Rock, an enormous sandstone block from the cliff behind Pueblo Bonito, fell and destroyed a large portion of the building. Additionally, more than 100 years of excavations and development have obscured or removed almost all traces of terrain modifications made by the Anasazi. These terrain modifications are critical elements in the interpretation of pre-Columbian roads and other earthen cultural features, making the reconstruction project even more difficult.

A series of detailed contour maps of the canyon floor (one-foot contour interval), originally created in 1934, provide critical clues for the interpretation and positioning of the now hidden or destroyed landscape features. In addition to the 1934 maps, the research team has compiled information from a wide variety of sources to ensure the virtual reconstruction accurately represents the canyon as it was several centuries ago. The supporting information used in this project includes oblique aerial photography taken by Charles Lindberg in 1929, terrestrial photography taken in the late 1800s and early 1900s, excavation notes, published reports, high-resolution multispectral imagery, and subsurface geophysical data.

With help from Hexagon Geospatial's software, Pueblo Bonito is slowly being reconstructed. Using IMAGINE Photogrammetry, block triangulated stereo models were created from 1:3000 scale aerial photographs taken in 1973 for use in Stereo Analyst® for ERDAS IMAGINE®. With Stereo Analyst for ERDAS



IMAGINE, the team captured 3D data in shapefiles to fill in landform data not present in the original 1934 maps. The composite landform data was then modified to reflect how the actual architectonic landscape might have looked for each major construction stage. In addition, the team created polygon shapefiles containing information about feature height, feature type, and time of construction. The landscape TIN (triangular irregular network) data and shapefiles were then seamlessly integrated into ERDAS IMAGINE for use in IMAGINE VirtualGIS®. With IMAGINE VirtualGIS, the team created fly-through simulations throughout the reconstruction of Pueblo Bonito, which allow easy visualization of the buildings and their relationships to the surrounding environment.

Integrating data from disparate sources via GIS technology is the closest historians and archaeologists can come to creating an approximate model of this icon of Southwestern history. The reconstruction of Pueblo Bonito is as accurate as it can be, given the time and resources available. In 1998, during the initial phases of the project, hand drafting and solid modeling with polystyrene were used. It quickly became apparent, however, that these techniques could not satisfy the need to interactively integrate data from widely different sources. Only after conversion to the digital medium in a geospatial

framework, could the many layers of information be integrated in a meaningful way. This conversion effectively elevated the project from an exercise in producing interpretative graphics, to the implementation of a process for producing an analytical model composed of spatially accurate, real-world coordinates in 3D space. In the former, graphics were an end product useful only for interpretative illustration. In the latter, graphics are but one product of an integrated spatial/textual database.

The GIS Center is building an interactive GIS database to organize and maintain research data, with the aim of facilitating future research of Pueblo Bonito and its surrounding areas. Innumerable artifacts — including bones, beads, and pottery — have been found in Pueblo Bonito over the years, making it difficult to manage, classify, and organize. By rebuilding Pueblo Bonito with the aid of GIS technology, the GIS Center can now create a spatial database for these artifacts.

The GIS team's work on Pueblo Bonito is ongoing, as the mapping, documentation, and interpretation of Anasazi architecture and architectonic landscapes are an interactive learning process. For example, while the team's current 3D simulation of Pueblo Bonito is complete, the team is moving on to other locations in Chaco Canyon. This new location may yield new knowledge that would be applicable to Pueblo Bonito, arming the team to revisit projects that may have been previously completed.

The objective of the Pueblo Bonito project is to initiate an informed, long-term management strategy of the site that serves the preservation, protection, research, interpretation, and Native American communities equally. Although preliminary in nature, this research has allowed the unveiling of a new image of Chaco Canyon, where the stereotype of the farming village has given way to a vision of powerful public architecture at a regional center in the Meso-American tradition. Due to the lack of structural stability, as well as other concerns, Pueblo Bonito will never be rebuilt. With the information learned via GIS technology, the GIS Center will rebuild Pueblo Bonito in virtual reality so that future generations can appreciate the complexity of the structure.

ADDITIONAL NOTE

The Smithsonian Press published a volume on Pueblo Bonito in the Spring of 2003 entitled "Pueblo Bonito, Center of the Chacoan World." The volume includes a chapter devoted to the reconstruction of this icon of Southwestern history.

For more information about the Pueblo Bonito project, contact the McKinley County GIS Center at +1 505 863 9517.



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