# Experimental Archaeology: Research Oriented Construction of a Southwestern Adobe Pueblo Room Aaron Trumbo (University of Colorado) and Allen Denoyer (Archaeology Southwest)

Experimental archaeology is a useful tool for improving our understanding of prehistoric technologies and testing archaeological interpretations. The "Hands On Archaeology" project at the 2014 Archaeology Southwest / University of Arizona Upper Gila Preservation Archaeology Field School focused on the experimental construction of a single-story adobe pueblo room in the style of the Cliff phase (AD 1300-1450+). This project was done in conjunction with limited excavation in three Cliff phase rooms at the Dinwiddie site, which provided information on building materials and construction styles. Experimental studies during construction of the adobe room improved our understanding of both labor effort and the construction techniques required to produce the types of Iwalls and features observed in the excavated rooms. A full-scale adobe room and a portable small-scale model allow us to share what we learned with the public in different venues. This ongoing project will continue to generate data on the durability and maintenance required for this type of structure.



#### **Background**

The experimental construction of both the full-scale room and the small-scale model was done within the context of the greater research design and educational goals of the 2014 Archaeology Southwest / University of Arizona Upper Gila Preservation Archaeology (UGPA) Field School. During the field school's second field season a the Dinwiddie site (LA 106000), research continued to follow Archaeology Southwest's ongoing investigation of late-prehistoric communities within the Upper Gila area This research examines how the 14<sup>th</sup> century arrival of Kayenta migrants affected existing communities, social systems, and resources. Moreover, how did migrants and local people from diverse cultural backgrounds form cohesive villages?

The 2014 field season at Dinwiddie saw the partial excavation of two Cliff Phase (AD 1300-1450+) adobe rooms threatened by erosion and road construction, and the re-excavation of a room previously excavated by avocational archaeologists in the 1960's. Research focused on ceramic and architectural evidence of migrant and indigenous communities, as well as evidence of cultural integration of these groups, visible in the presence of Salado polychrome pottery.

The educational goals of the UGPA Field School include training in field and laboratory methods, as well as the ethic of preservation archaeology. Site disturbance within preservation archaeology is limited to minimal excavation of threatened archaeology sites. Experimental archaeology projects contribute to the goals of preservation archaeology by providing additional, non-destructive avenues for research and education.

This project is part of Archaeology Southwest's "Hands-On Archaeology" initiative, directed by Preservation Archaeologist, Allen Denoyer. Within this program, students use ancient tools and techniques to gain insights into the skills that enabled people to survive in the southwest landscape. These insights allow participants to develop a deeper understanding of the significance of archaeological sites and artifacts.

#### **Purpose and Goals**

A single-story adobe pueblo room was constructed on the Rocker Diamond X Ranch in Mule Creek, New Mexico during the UGPA Field School (May 28 – July 5, 2014). The purpose of this experimental construction project was to: (I) aid in the interpretation of, and gain a deeper understanding of the architecture uncovered by our excavation, (II) understand the skill and effort required to construct these types of structures, (III) as well as to promote the ethic of preservation archaeology. Both the full-scale room and small-scale model, contribute to the goals of preservation archaeology by allowing students and instructors to experience a hands-on and tangible representation of ancient architecture without the need to further deconstruct the structural elements of threatened and non-renewable sites. Goals of the experimental archaeology project:

- Gain understanding of construction methods including: material components and their proportions within the adobe matrix, and pre-historic tool use and building
- Gain understanding of time and labor requirements for adobe pueblo construction.
- Test interpretations of architectural elements observed within the site and excavation units.
- Establish a starting point for further experimental studies and follow-up research.
- Provide an attractive venue for public interaction and the dissemination of archaeological knowledge and the preservation ethic.

The site selected for the experimental structure was flat, unimproved pastureland. Excavation for the building's foundation was accomplished with digging sticks and woven baskets. The digging sticks were fashioned with a flat, blunted chisel point from oak branches (approx. 75 cm long by 6 cm in diameter, see figure 5). Excavated soil and subsequent adobe components were measured and counted with two dish-shaped woven baskets, each being 3.5 liters in volume (Table 1). Composite building materials (i.e., adobe and plaster) were mixed by hand in two subterranean basin-shaped pits, each approximately 50 cm in diameter and 40-50 cm deep. All building materials, including sand/gravel, clay, river cobbles, and timber, were sourced from the Rocker Diamond X Ranch and delivered to the construction site with trucks. Water was provided by the ranch via spigot and hose, and was measured with a one liter measuring cup. The adobe was a mixture of sand and gravel, screened clay, and water. The proportions of each component in the adobe mixture varied with experimentation and weather. Initially, dry sand and clay were added in equal amounts to 3-4 liters of water in a 1-1-1 ratio. After monsoon rains soaked the sand and clay "source" piles, we reduced the volume of water by half. Through trial-and-error, we found that the most appropriate mixture had a consistency of cookie dough, which was viscous enough not to slump when added to the walls. The building sequence:

1) The rectangular room was laid out on level ground to be 5.0 m by 3.8 m, with the long axis aligned north-south. The hard clay soil within the building footprint was moistened to make digging easier.

(2) Using digging sticks, 366 baskets of overburden and soil were excavated from a footing (i.e., foundation) trench approximately 40 cm wide by 20 cm deep, and directly below what would be the four exterior walls.

3) Oblong river cobbles (i.e., cimientos) ranging from 20-50 cm long and 10-30 cm wide were placed into the trench and arranged end-to-end in two rows (an inner and outer ow). The cimientos were cemented in place with adobe, and typically rose several centimeters above the ground surface (Figures 1 and 9).





Fig. 2. View from south. Sequential layering of puddled adobe

(4) The walls were constructed in the "puddled adobe" style typical of the "Cliff Phase" pueblos of the region. Puddled adobe is the application of wet adobe globules or "blobs" to the top of a wall; much the same way bricks are added in courses to a "running bond" brick masonry wall. Blobs of adobe were removed from the mixing pits by hand, and were formed into "wet bricks" (approximately 30 cm long, 20 cm wide, and 10 cm tall) directly on top of the cimiento foundation and subsequent adobe courses. Unlike brick or stone masonry, the wet blobs do not require mortar, and could be shaped and fused to the preceding course (Figures 2, 3, and 4).

Initially, 3 people could add 10 cm of wall height (i.e., one course) to all 4 walls every 2 hours. At this rate, the adobe would dry and become firm enough to immediately overlay with an additional course. However, due to the increased weight of the additional course, a drying time of 3-4 hours was necessary before application of subsequent courses. As participants gained more experience, 2 people could accomplish the same progress within the same time frame (an application rate of approximately 4 lineal meters of adobe/person/hour, including mixing time). A small door was positioned in the center of the east wall and was demarcated with a tabular stone threshold. A timber lintel was placed spanning the door opening to support adobe courses above the door (Fig. 7).



Fig. 5. Digging a posthole with a digging stick

Fig. 6. Setting one of two beam support posts

5) When the wall height reached approximately 1.75 meters, a timber post-and-beam superstructure was added to support the eventual roof. Two vertical posts of approximately 30 cm in diameter were set into separate 60 cm deep holes along the north-south axis of the building, and rose vertically to meet the wall elevation. The top ends of the posts were saddle-notched to accept a 6.0 m long by approximately 30 cm diameter beam (viga), which sat along the north-south building axis, and was supported by the north and south walls and two posts. Eventually, the beam, along with the east and west walls, will support timber cross-members (latillas), which will support a flat adobe roof and hatch entrance (Figures 6 and 7).

(6) After the walls sustained erosional damage from a monsoon downpour, a plaster of clay, sand, and water (ratio: 1-1/4-1) was applied to the wall surfaces in a 1 to 2 cm veneer (Fig. 8).

Materials	Liters	Cubic Meters	Baskets*
Soil excavated from footing	1280	1.3	366
Sand/gravel	4587	4.6	1311
Clay	6889	6.9	1968

able 1. Volumes of soil and adobe components for experimental pueb room reconstruction. (\*basket = 3.5 liters)

Fig. 3. Extracting an adobe "blob" from a mixing pit.

Fig. 4. Forming and fusing puddled adobe.



## **Observations and Inferences**

#### Observation

1. Puddled adobe must be mixed and without slumping, and wet enough to av Horizontal courses of wet adobe must d support subsequent courses of adobe v

2. Vertical and horizontal cracks in add similar to cracks observed in the excav



3. Soil excavated for the footing trench structure to the clay component of both matrix. Therefore, the soil was incorporate and walls.

4. Artifact inclusions were observed wit rooms, including sherds and lithic debita

5. Monsoon rains near the end of the fi deteriorated the experimental adobe wa minimized rain erosion.

6. Field school staff, students, and fami community successfully participated in t

#### **Community Engagement**

The experimental construction of a puel operations attracted the attention of visit community members. Many of these ob project. In order to reach a larger audier was included in the field school's comm was a valuable tool for representing our architectural features within our excavat familiar with, and live among the area's





	Inference		
oplied dry enough to hold its vertical form bid catastrophic cracking from rapid drying. y to significant hardness in order to thout distorting.	<ul> <li><b>a.</b> Assuming adequate labor and resources, the overall rate of puddled adobe construction is constrained by the necessity of proper drying time between applications of subsequent courses.</li> <li><b>b.</b> Additional labor and materials will not increase productivity of the constructio project beyond its drying time constraint.</li> </ul>		
<text></text>	<ul> <li>c. Puddled adobe fractures (usually superficially) along boundaries of horizontal courses and vertical joints.</li> <li>d. The walls of the 3 excavated "Cliff Phase" rooms were constructed using the puddled adobe technique, and were not an undifferentiated and "monolithic" slab of adobe.</li> <li>e. Cracking, which represents water loss and contraction of individual puddled adobe "blobs," demonstrates the uniformity of conditions and constraints faced by prehistoric builders and modern researchers. Solar radiation, arid climate, and availability of water affect adobe's drying time, thus, the necessity of elapsed time between applications of subsequent adobe courses.</li> </ul>		
of the experimental room was similar in the experimental and pre-historic adobe ted into the experimental adobe mixture	<ul> <li>f. Sand, clay, and gravel for adobe are relatively concentrated at the nearby river, however, appropriate soils directly from prehistoric sites may have been used, at least in part, to make adobe.</li> <li>g. Discarded artifacts in the matrix support the idea of site-sourcing of some adobe components.</li> </ul>		
in the adobe matrix of the pre-historic ge.	h. Artifact inclusions in the pre-historic adobe point to a lengthy occupational history of the site as soil and recycled adobe littered with artifacts were incorporated into later construction episodes.		
ld season (July) quickly eroded and s. Coating the walls with a clay plaster	i. Periodic and seasonal maintenance and repairs would have been routine for people inhabiting puddled adobe structures, and will be an ongoing part of the experimental archaeology project.		
y, along with members of the local ne construction of the adobe room.	<b>j.</b> Construction of a puddled adobe structure is not necessarily relegated to specialists, and could be managed by a single-family unit with other subsistence responsibilities.		
lo room adjacent to the field school's base on ng scholars, professionals, and local ervers became hands-on participants in the ce, a small-scale model of the pueblo room unity archaeology fair. This small-scale replie experimental project and demonstrating the on units to an interested public who are nany pueblo ruins.	Image: structure in the second structure is in the second structure in the second structure in the second structure in the second structure is in the second structure in the second structure is in the second structure in the second structure is in the second structure in the second structure in the second structure is in the second structure in the second structure is in the second structure in the second structure is in the second structure in the second structure is in the second structure in the second structure is in the second structure in the second structure in the second structure in the second structure in		



Construction of adjacent, connected rooms and multi-story rooms Taphonomic studies following: 1) cessation of construction and maintenance efforts, and 2) intentional burning of an adobe room

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Allen Denoyer is a preservation archaeologist and ancient technology expert with Archaeology Southwest.

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## **Archaeology Southwest**

