The Archaeology of Midas and the Phrygians

Recent Work at Gordion

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17

Architectural Conservation at Gordion

Mark Goodman

After a catastrophic fire destroyed much of the Old Phrygian Citadel in the late 9th century BC, the Phrygians buried the ruins under 3–5 m of clay soil. The architectural plan of this Citadel, protected from subsequent stone robbing and reuse, was found to be largely intact. Excavations of this Destruction Layer in the 1950s and 1960s unearthed some of the best examples of monumental Phrygian architecture in Iron Age Anatolia.

Preserving and presenting these architectural ruins has been the focus of site conservation at Gordion. The development of new techniques of on-site conservation will have a favorable impact on other sites in Anatolia.

The Site

The exposed Old Citadel, located within an excavated area of approximately 2.5 hectares (Fig. 17-1) includes the Citadel Gate (A), outer and inner Palace Courtyards flanked by freestanding megaron structures (larger main room entered through smaller anteroom or porch) (B), and the Terrace Building Complex on a raised terrace southwest of the Palace Quarter (C). Ramps and securable passageways controlled movement within the city, with at least two staircases linking the Palace Complex with the terrace above.

Although following the basic megaron plan, each building is unique in dimension and detail of construction. Megarons 1 (M1) and 4 (M4) were constructed of mud brick. Megarons 2 (M2) and 3 (M3) were constructed of a combination of mud brick and stone masonry. Close analysis of the Palace Complex indicates a cumulative plan that resulted from at least two major building campaigns (Sams 1994b). The Palace Quarter, including the Citadel Gate, M1-3, and the surrounding courtyards, was constructed first. Megarons 2 and 3 were later incorporated into the retaining structure of the massive platform upon which the Terrace Buildings and Megaron 4 were built.

Site Conservation: Background

Site conservation is not a new concept at Gordion. Excavation in the 1950s and 1960s exposed many walls that required structural support. Excavators used rubble debris to buttress the walls. Rubble was also packed into voids remaining from the disintegration of timber stringcourses. These measures addressed safety

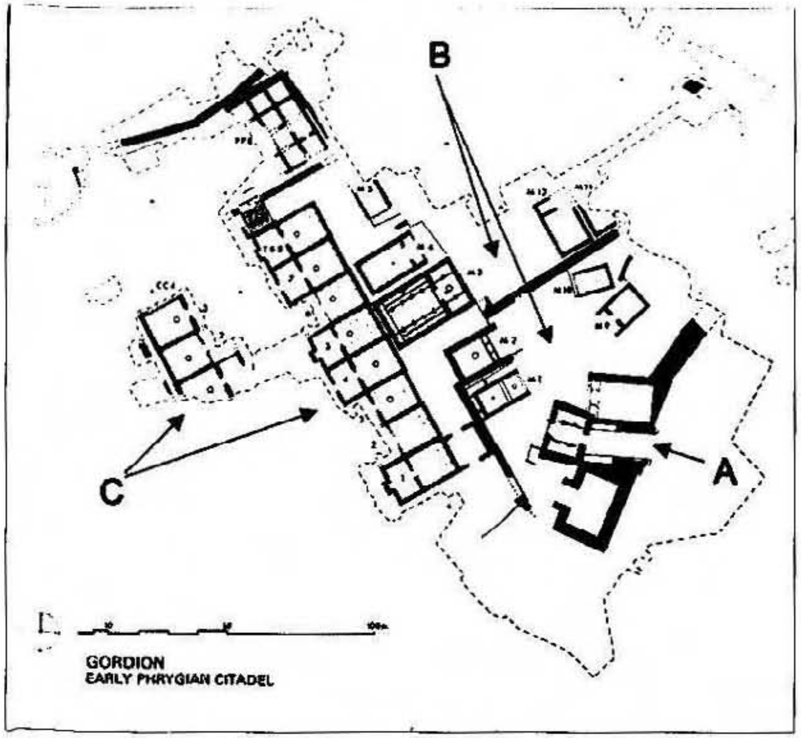

Figure 17-1 Exposed elements of the Citadel Complex at Gordion. Courtesy of Gordion Excavations.

and stability during excavation, but they were neither adequately documented nor systematically applied.

By the early 1960s, deterioration of exposed megarons prompted the reburial (backfilling) of M1-3 using several different techniques with varying degrees of success, all of which resulted in a negative visual impact. This is particularly true of the Palace Megarons, which played a major role in defining the city plan by retaining the Upper Terrace (Fig. 17-2). The erosion and reburial of Megarons 2 and 3, and the modern projection of that Terrace into the backfilled room of Megaron 1, have distorted a key topographical and social boundary of the city.

Conservation Strategy

For more than a decade the conservation team at Gordion has been evaluating the effectiveness of previous efforts in order to develop a strategy appropriate for the site (Koob et al. 1990). It was recognized that the exposed architecture was

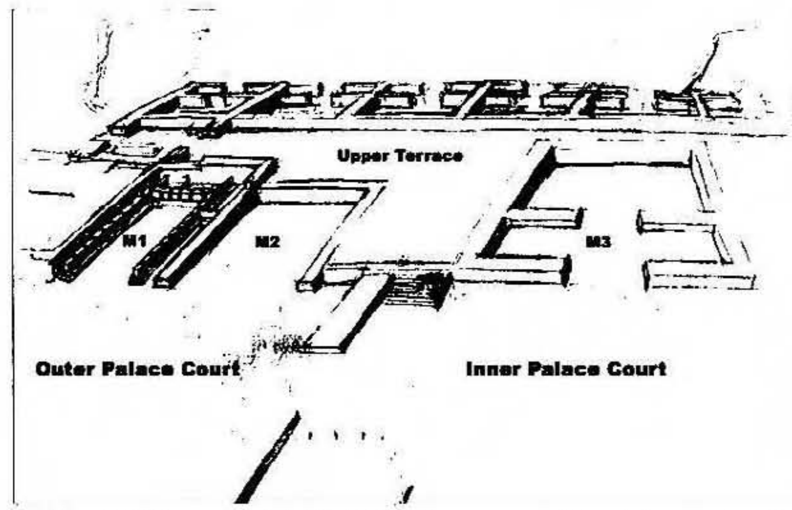

Figure 17-2 Topography of the Citadel Complex as excavated. Note the incorporation of Megarons 2 and 3 within the retaining wall of the Upper Terrace. Drawing courtesy of Banu Bedel.

deteriorating at an accelerating rate that could not be controlled by consolidation or sheltering alone, given current budget constraints. Conventional techniques of reburial protected the ruins but distorted the topography and legibility of the archaeological site.

To reverse this trend, it was necessary to develop a conservation program that would engage the entire site as an archaeological landscape, preserving the fabric and legibility of the Citadel Complex. It also had to be economical in order to be implemented and maintained on a wide scale using available resources and skills.

As a preliminary step, principles of conservation and a site risk assessment were drafted to establish the conservation philosophy at Gordion. Highest priority was given to protecting significant features threatened by structural collapse, such as the Citadel Gate, Terrace Building Complex, and exposed portions of the Megaron Buildings (see Tables 17-1 and 17-2).

The Citadel Gate

The Citadel Gate, built in the 9th century BC, is the best-preserved architectural monument exposed at the site (Fig. 17-3). Over 10 m high, it guarded a major entrance into the Palace Complex and defined the perimeter of the Citadel.

The gate is built of roughly squared and chinked limestone with earth mortar filling gaps between the stones. Walls were plastered with mud, and possibly lime washed, to minimize footfalls and provide a protective and aesthetic skin (Young 1956). For enhanced stability, the walls were battered inward at the entrance approximately 5 cm for every 1 m in height.

Table 17-1 Site Conservation Guidelines

I. All conservation and restoration work should follow the principles codified by international charters (e.g., Venice 1964, Lausanne 1990), stressing minimal intervention and maximum retention of historic fabric. As the bulk of exposed architectural remains date from the Early Phrygian Period, it is natural to emphasize this period as the main theme of the site. However, it is important to represent the scope and configuration of all occupational phases, using graphics and text to present the state of knowledge regarding the entire occupational history of Gordion.

II. Topography played a major role in defining the different urban components of Phrygian Gordion. Topographical features of the site, including terraces, ramps, access routes, etc., should be preserved to illustrate the plan and functions of the ancient city.

III. Each structure should be fully documented before, during, and after intervention.

IV. All materials introduced into the site should be structurally and chemically compatible with historic building fabric and free of cultural material (such as pottery), which could contaminate the archaeological record.

V. The intent of conservation should be to present and preserve the form and fabric of the architectural features of the site for future analysis. Thus, any intervention should follow the original technique and character as accurately as possible, while remaining distinguishable from original fabric in a subtle, aesthetically acceptable, and consistent manner. The scope of architectural restoration should be limited to reintegrating the configuration of structures as excavated.

Table 17-2 Site Risk Assessment

Priority I (integrity of structure): Significant monuments in imminent danger of structural collapse. These include the Citadel Gate and sections of the Terrace Building Complex.

Priority II (integrity of structural components): Structural fabric in danger of erosion or collapse. These include upper courses of walls, steps, and paving which are directly exposed to weather erosion (especially freeze/thaw cycling)

Priority III (integrity of site aesthetic): Restoration and re-integration of missing features considered critical to interpreting the site. These include collapsed walls, eroded terraces, etc. which are documented but have disappeared through erosion or post excavation activities.

Excavation photographs taken in 1955 reveal relatively tight and flat walls retaining plaster in areas protected from the weather. To prevent water penetration over the exposed top of the gate, a cement capping was applied in 1956. This capping soon developed cracks, allowing water to erode and weaken the bond between the masonry core and the veneer (Rogers 1989). Although replaced in 1989 by an improved capping/drainage system, exposure to weather and seismic activity accelerated the deterioration and detachment of load-bearing veneer stones. This became particularly evident in the south chamber, where an ominous bulge developed.

In 1999, structural engineer Conor Power developed a simple method using a plumb bob to measure structural movement at critical points along the bulge (Fig. 17-3). As displacement continued, particularly during seismic activity, remedial work was deferred for safety reasons pending construction of supportive bracing. By 2001 sufficient funding enabled the installation of supportive scaffolding and trials of a specialized consolidation technique known as "gravity grouting" to stabilize the gate in its original configuration. As the name implies, the method uses gravitational pressure to inject a hydraulic lime consolidant into the wall, restoring the bond between veneer and core. Properly done, grouting can effectively preserve the structural and aesthetic integrity of a monument without having to dismantle and rebuild its components.

The grouting system was tested on a relatively stable section of fortification wall south of the Citadel Gate (Fig. 17-4). The apparatus uses standard PVC pipe, firehose, and a specially constructed 70 liter grout bucket raised by a compound pulley to a height at least 2 m over the injection point. The mortar injected into the core is pumped upwards in grout "lifts" to ensure effective filling of interior voids.

Following successful trials, the system was adapted in 2002 to begin grouting the south court of the Citadel Gate. The wall face of the structure was digitally photographed and rectified to document pre-consolidation conditions and provide a visual reference for recording the amount of mortar injected into the walls. Additional scaffolding was used to construct an expanded work platform, paying particular attention to creating a safe and efficient setup to mix, move, and inject the large quantities of grout needed for this massive structure. The mining railroad originally used to excavate the site was reassembled to transport materials to the mortar mixer. A second railroad was constructed on the scaffold using a specially modified "grout wagon" to transport mortar to pumping stations at intervals along the wall (Fig. 17-5). Complete stabilization of the southern court is projected to take three more seasons, after which work will begin on the north court building.

The Terrace Building Complex

The size (over 100 m long) and plan of the Terrace Building (TB) Complex embody the urban character of Iron Age Gordion, presenting a vivid picture of food and textile production on a grand scale (Sams 1995; Chapters 2 and 6 this volume)

Figure 17-3 Monitoring structural displacement of the Citadel Gate using plumb lines, August 1999.

The interlocked walls of the TB Complex indicate construction within a single phase (mid to late 9th century BC). Various types of ashlar limestone were used, with wooden timbers serving as leveling courses and to provide vertical supports for the roof and inner galleries.

The timber-laced masonry construction of the TB was particularly vulnerable to fire. Combustion of the timber stringcourses within the masonry caused the walls to splay outward and collapse. Both Terrace Buildings were destroyed and abandoned following the 9th century BC catastrophic fire marking the end of the Early Phrygian Period.

Although rubble buttresses built during excavation helped to support the unstable walls, they were aesthetically incompatible with the original ashlar walls. Because the buttresses were not applied systematically, many walls continued to deteriorate. In some instances, the buttresses themselves had eroded and were no longer effective.

The walls were also exposed to severe weather conditions, including significant winter freeze/thaw cycling. Comparisons of excavation photographs reveal that

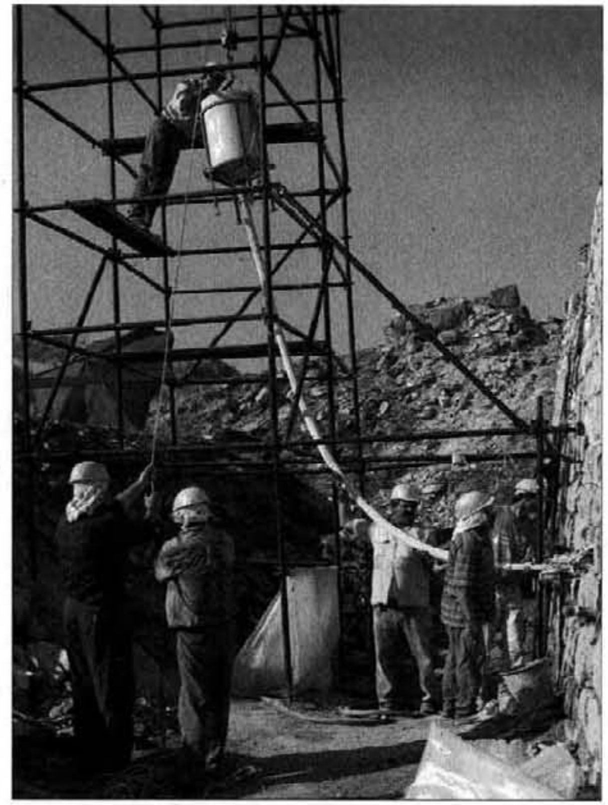

Figure 17-4 Grouting system being applied to the Citadel Gate.

significant deterioration occurred after excavation (Fig. 17-6). The outward splay of walls increased due to seismic activity and "frost wedging." Numerous fire-damaged stones disintegrated. Entire features of buildings, such as doorjambs, had completely disappeared in some places.

Interpretive Stabilization of the Terrace Building Complex

The most pressing need was to arrest the collapse of unstable walls by employing a more effective method of supportive buttressing and to protect exposed walls from freeze/thaw cycling. Evaluation of previous buttressing suggested the need to incorporate additional features such as wall plasters and ovens, and include an effective method of capping protection. It was necessary that the buttressing and capping be distinguishable from the original building fabric and also be economical and versatile enough to allow for systematic implementation on the entire range of site architecture (See Table 17-3).

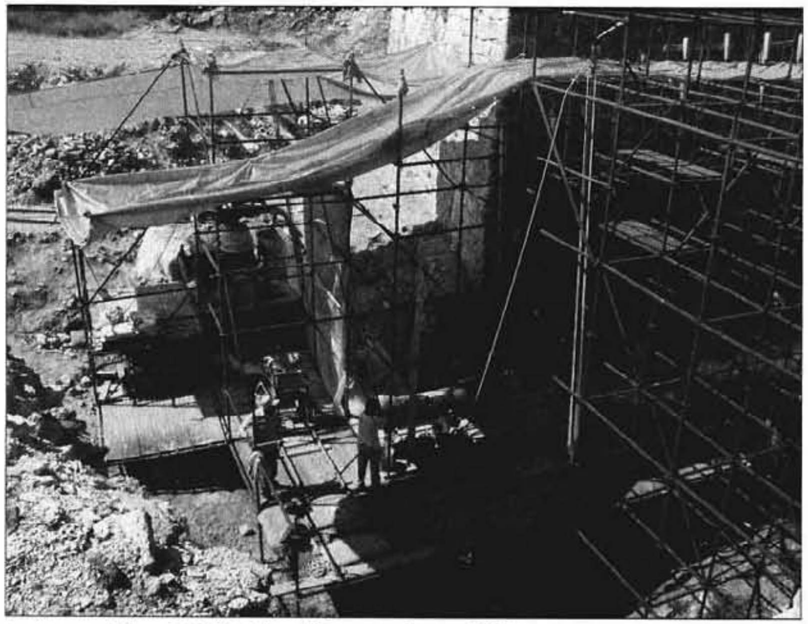

Figure 17-5 "Railroad" constructed on scaffolding to transport mortar to pumping stations for grouting the walls.

Supportive Buttressing

In 1999, a pilot program of supportive buttressing was applied to several endangered walls of TB1, using burlap sandbags, which allowed the buttressed walls to breathe. Burlap offered a superior substrate for the application of protective dressing. It was locally available and inexpensive (ca. 30 cents/bag).

The area adjacent to the wall was documented, cleared, and graded to facilitate drainage (Pl. 8). Sections of extant wall plaster were photographed and covered with fine landscaping fabric (G2). Although geotextile was originally procured for this purpose, the unwoven material tended to adhere to and to remove friable wall plasters.

A bedding of coarse, clean sand (graded <3 mm) was spread in a 3-5 cm thick layer extending 1 meter from the wall base. The first course of sandbags was laid over this bedding layer, leaving a gap of approximately 30 cm from the wall. This gap was packed with sand, becoming progressively narrower as the buttresses were built up and battered inward approximately 60° for stability. The top course of sandbags, packed directly against the wall, was contoured to facilitate drainage.

Sandbag Protection

To prevent ultraviolet degradation it was necessary to protect the burlap from direct sun exposure using inconspicuous fabric protection less vulnerable to

Figure 17-6 TB-5 immediately after excavation, 1961, illustrates the condition as excavated. Courtesy of Gordion Archives.

theft. It was discovered that the unwoven polyester of geotextile adheres naturally to burlap sandbags, creating a form-fitting cover. As clean white geotextile is both conspicuous and degradable by ultraviolet radiation, the geotextile was saturated in a slurry mixture of lime-stabilized clay (Table 17-4). The resulting wet geotextile dressing was then molded to the contour of the sandbags. After drying, the geotextile was painted with two coats of clay/lime slurry. The technique was further refined to minimize water penetration into the buttress by covering exposed seams with expansive clay, burlap and saturated geotextile (Fig. 17-7). The finished product is asthetically pleasing, with light brown buttresses contrasting with dark brown capping.

The exposed staircase attached to TB8 was treated in a similar manner, with missing stones visually reintegrated using sandbags molded to fit step dimensions.

Table 17-3 Criteria for Interpretive Stabilization System

1. *Protective*: should stabilize structural remains in their existing configuration and protect from weather erosion, particularly freeze–thaw cycling
2. *Compatible*: should be physically, mechanically, and chemically compatible with historic building materials of the site
3. *Reversible*: should be easily reversible and re-workable, reusing the bulk of material to maintain and upgrade the system
4. *Economical/Sustainable*: should benefit the local economy by employing local materials and labor, and remain inexpensive enough to be implemented and maintained on a wide scale
5. *Flexible*: should incorporate architectural elements (wall plasters, ovens, etc) and be applicable to features such as staircases, restored structures, etc.
6. *Aesthetic*: should be easily distinguishable from the original fabric, while remaining visually compatible with the site
7. *Interpretive*: should preserve and if possible enhance visitor interpretation of the site. Missing or incomplete features (properly documented) can be schematically represented to preserve clarity of form. The system should also differentiate restored features while integrating them in the general scheme

Table 17-4 Conservation & Restoration Formulae

Application	Constituents & Bulk Proportions					
	Soaked Hydrated lime	Local clay	Acrylic Co-polymer emulsion	Sand ≤ 3mm	Ceramic ≤ 4mm	Binder/ Aggregate Ratio
Buttress protective slurry (2000)	20 liters	400 Kg	—	—	—	-
Protective slurry (2001)	20 liters	400 Kg	5 liters			
Restoration mortar	3 liters (27%)	—	—	7 liters (64%)	1 liter (9%)	1-2.6

Figure 17-7 Applying protective Geotextile dressing over sandbag buttresses, August 2000.

Capping

In 1988, additional sections of the Terrace Building were exposed during excavation. As long-term exposure was clearly damaging, the excavators capped the newly exposed walls with earth-covered polyethylene sheeting anchored by small stones. This provided effective protection against freeze/thaw damage. However, since the earth was obtained from excavation dump, it contained cultural material that could eventually contaminate the archaeological record. Various alternatives, such as textured concrete, were rejected as obtrusive and inappropriate for archaeological sites.

The search for an appropriate capping material ended in 2000 when a large amount of clay was discovered along the road leading to the site. This local clay had been used in ancient earthwork projects—including tumuli, fortifications, and terraces—and for flood protection. Geomorphologic research at Gordion has characterized this soil deposit as red fan clay, a highly expansive mixture of illite and montmorillonite (Marsh 1999). The Phrygians buried their destroyed citadel using this clay, creating a protective seal until excavation nearly three thousand years later. It is an early example of a protective material used (albeit unwittingly) to preserve the ruins of an ancient site.

The potential for a plentiful and culturally clean material for capping the walls was quickly recognized at the Gordion site. By expanding when saturated with water, such clay provides an efficient moisture barrier, restricting water penetration into the walls. Upon drying the shrinkage and cracking of the clay allows for the release of moisture that had penetrated into the wall and imparts a rustic aesthetic appropriate for an archaeological site.

Figure 17-8 Tamping clay capping over buffered polyethylene, anchored at margins by rubble "capstones," July 2000.

The 1989 technique was implemented in the 2000 season, using clay as the capping material, with the following modifications. Following documentation, the wall tops were cleaned and a layer of sand contoured for drainage was applied to absorb condensation. The sand was covered with a double layer of 0.2 mm UV-resistant polyethylene sheeting later changed to geotextile for enhanced permeability, secured by "cappingstones" of similar color to the original wall. A deep layer of clay was mounded and tamped over the polyethylene (Fig. 17-8). To cover walls preserved to different heights, larger clods of clay were used to retain the finer material.

SITE INTERPRETATION

As work progressed, the potential to facilitate visitor interpretation was recognized and exploited, by schematic representation of the entire building

Figure 17-9 Terrace Building after interpretive stabilization. Supportive buttressing and capping protects eroded structure while providing a schematic and reversible restoration of the building plan. Pending evaluation of the stairway protection, the cinderblock encasement can be removed and the geotextile treatment extended along the steps to recover original site topography.

plan. Where local collapses created gaps in the walls, the caps provide visual linkage between surviving wall sections (Fig. 17-9). Protective buttressing of eroded doorjambs schematically restores features while preserving the original material underneath. As the Terrace Building was built of stones obtained from different sources, this was conveyed by using compatible rubble to retain the clay cappings. The contrast between the dark clay and the lighter earth shades of the site makes it possible to represent portions of the TB Complex that are obscured by eroded baulks (such as the cross walls of Terrace Building 3) by superimposed cappings.

DISCUSSION

The Interpretive Stabilization System implemented at Gordion follows the conservation guidelines (see Table 17-3) while protecting the archaeological remains. Environmental protection is provided by reducing the two main causes of freeze/thaw cycling: (1) water saturation of the masonry pores to 91%, and (2) exposure of water-saturated masonry to temperatures fluctuating above and below freezing.

The expansive clay, the mildly hydrophobic geotextile dressing, the coarse sand within the buttresses, and the configuration of the buttresses themselves are all designed to direct water away from the walls, minimizing water absorption while providing a permeable, expanded area to facilitate evaporation and drainage (Fig. 17-10). The structural mass of the buttresses counterbalances the unstable configuration of the walls and provides insulation from surface temperature fluctuations.

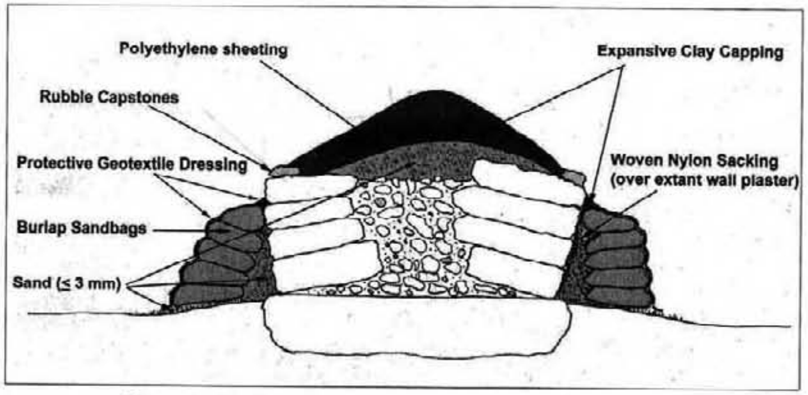

Figure 17-10 Cross-section of interpretive stabilization technique.

Cost and Maintenance

Interpretive stabilization of the Terrace Building took five months to complete, at a total cost (including materials and labor) of approximately $40,000, averaging about $140/m^2$ of protected wall. Maintenance is projected to be ca. $400 annually, using local materials and labor to reapply the slurry and clay as needed.

Assuming the fabric form retains its integrity, the sand buttresses are expected to harden naturally through periodic wet/dry cycling. If the buttresses deteriorate through lack of maintenance, both sand and clay should still function as a protective berm. This system is both reversible and reworkable, using bulk materials that can easily be incorporated into more durable protective systems if necessary.

Monitoring

Monitoring at Gordion has two aspects—efficacy of protection and durability/*maintainability* of the protective system itself.

In 2000, field trials involving inundation of buttressed walls were carried out to evaluate water saturation adjacent to the original wall surfaces. While moisture did penetrate into the buttresses, at no point was saturation reached within the buttress core. The 2001 season commenced with inspection of buttresses and cappings (Fig. 17-11). As expected, a percentage of mud slurry applied onto the buttress had washed away, and several cappings required minor refittings and replenishment of clay. For improved durability, the slurry was amended with 2% acrylic emulsion of Volkan co-polymer binder for exterior paints.

A section of buttressed capping was dismantled, revealing no signs of frost damage within the protected walls. Since frost can be an insidious process manifesting itself only after several years, a simple monitoring method was

Figure 17-11 Restored Terrace Building unit 4 and stabilized complex after one year. Section of mortared wall capping (left of lower crosswall) is exposed to compare with protected section, June 2001. Courtesy of Richard Liebhart.

implemented in 2002: the insertion of a sacrificial material within the buttresses and capping, with control samples exposed for comparative analysis. This material consists of cast slabs of ash-modified lime mortar, a material particularly susceptible to frost damage (Goodman 1998).

Pending evaluation and possible modification, the system can be expanded to preserve all features of the site. The interpretive stabilization of palace megarons could restore the eroded boundary between the Palace and upper Terrace, recovering the original topography of the site.

Future work at Gordion includes ongoing stabilization of the Citadel Gate and updating the program of site presentation, using non-intrusive viewing stations and brochures to provide an interpretive map of the site. This includes developing a site conservation/presentation website and using digitized images and three-dimensional visualization for an exciting and informative experience of ancient Gordion.