Gordion 2006
Field Report for Terrace Building 2

Prepared by Sarah Cleary and Evin Erder

Field Season 2006 (June – August 2006)
University of Pennsylvania
Department of Historic Preservation
Professor Frank Matero
TABLE OF CONTENTS

List of figures

SECTION 1: INTRODUCTION........................................................................................................... 7

SECTION 2: ARCHITECTURAL DESCRIPTION............................................................................... 7
  2.1 Terrace Building Complex..................................................................................................... 7
  2.2 Terrace Building 2.................................................................................................................. 9

SECTION 3: CONSERVATION HISTORY...................................................................................... 10
  3.1 Previous interventions for Terrace Building Complex.......................................................... 10
  3.2 Previous interventions for Terrace Building 2...................................................................... 14
  3.3 Previous conditions for Terrace Building 2.......................................................................... 14

SECTION 4: OBJECTIVES/GOALS................................................................................................. 15

SECTION 5: METHODOLOGY........................................................................................................ 15
  5.1 Documentation....................................................................................................................... 15
  5.2 Condition Survey.................................................................................................................... 16
  5.3 South wall – testing program.................................................................................................. 18
  5.4 Stabilization and reburial program......................................................................................... 26

SECTION 6: CURRENT CONDITIONS/OBSERVATIONS............................................................... 29

SECTION 7: TREATMENT PROGRAM............................................................................................ 31
  7.1 Documentation....................................................................................................................... 31
  7.2 Condition Survey.................................................................................................................... 32
  7.3 South wall – testing program.................................................................................................. 33
  7.4 Stabilization and reburial program......................................................................................... 34

SECTION 8: CONCLUSIONS AND RECOMMENDATIONS......................................................... 39

Sources Cited.................................................................................................................................. 41

APPENDICES (due to large files inserted for appendices no page numbers have been listed)

Appendix A. Plan of site
Appendix B. Figures
Appendix C. List of samples taken from site for testing at University of Pennsylvania and Middle East Technical University
Appendix D. Condition Survey
Appendix E. Schematic Drawings of the Terrace Building 2 south wall sections – Sections I – III
Appendix F. List of supplies used for the Terrace Building 2 Project (Summer 2006)
Appendix G. Images of Work/Interventions for the Terrace Building Project (Summer 2006)
Appendix H. Architectural Conservation at Gordion Summer 1999 Report (Mark Goodman)
Appendix I. Naomi Miller’s 2006 Report
Appendix J. List of plantings used for the Terrace Building 2 South Wall Pilot Program
Appendix K. Locations of HOBO Data Loggers Used for the Terrace Building 2 South Wall Pilot Program
Appendix L. Geology Report
Appendix M. Articles Related to the Terrace Building 2 South Wall Pilot Program
Appendix N. AJA Reports Providing Information Concerning Terrace Building 2
LIST OF FIGURES (unless specified all photographs courtesy of Sarah Cleary)

Figure 1. Site Plan (Courtesy of Voigt, 2006)

Figure 2. Plan of Terrace Building 2. Sketch from Gordion Field Notebook 100, C.H. Greenewalt and J. McLaughlin 1961.

Figure 3. Section illustration of earth/polyethylene capping installed on Terrace Building Walls. Figure courtesy of Mark Goodman “Interpretive Stabilization at Gordion, an Iron-Age City in Anatolia” in Conservation and Management of Archaeological Sites 5, no. 4, 2002

Figure 4. Terrace Building Complex from SE, 1998 (Photo courtesy of Mark Goodman)

Figure 5. Terrace Building Complex from SE, 2000 (Photo courtesy of Mark Goodman)

Figure 6. Plan of south wall elevation divided into sections used for condition survey and installation of pilot program

Figure 7. South wall of Terrace Building 2 - before

Figure 8. South wall of Terrace Building 2 – division of wall elevation into three main sections for pilot program Section I (left side), Section II (middle), Section III (right)

Figure 9. Diagram of slope created for “French drain”

Figure 10. Section I – installation of “French drain”

Figure 11. Section I – Kelly Wong removing clay capping

Figure 12. Frank Matero packing soil mixture

Figure 13. Section I: after installation of data logger

Figure 14. Section I – after reburial

Figure 15. Section II – installation of French drain

Figure 16. Section II: data logger set up in Pelican case

Figure 17. Section II – placement of soil

Figure 18. Section II – during slope installation

Figure 19. Section II – after installation of monitoring program and reburial

Figure 20. Section III – before

Figure 21. Section III – during installation of data logger for slope

Figure 22. Section III – during installation
Figure 23. Section III – after installation and reburial

Figure 24. Section III – during rain July 3 2006

Figure 25. Data logger installed in slope

Figure 26. Section I, south wall in TB2

Figure 27. South wall in TB2

Figure 28. Section II – after watering newly planted seeds and mudballs

Figure 29. Mudballs planted in the ground at the base of slope Section II

Figure 30. Forty-five degree angle slope created for reburial program

Figure 31. Mixture of sand/soil at TB2

Figure 32. Sieved soil used for reburial

Figure 33. Condition survey – cracking

Figure 34. Condition Survey – thin detachment

Figure 35. Condition Survey – thick detachment

Figure 36. Condition Survey – deteriorated mortar

Figure 37. Condition Survey – salts

Figure 38. Condition Survey - crusts

Figure 39. West wall Megaron 1 – animal burrowing holes

Figure 40. Hikmet filling in holes with stones

Figure 41. After – animal holes filled in

Figure 42. Evin Erder placing transplanted plants (*Poa*)

Figure 43. Hikmet watering the newly transplanted plants

Figure 44. Sarah Cleary placing mudballs on wall capping

Figure 45. Frank Matero demonstrating repointing

Figure 46. Frank Matero wetting down burlap bags placed over newly finished repointed areas
Figure 47. Efflorescence on north wall in Terrace Building 2

Figure 48. East wall in Terrace Building 1 – before repointing

Figure 49. Evin Erder and Gulsun Ozkan repointing

Figure 50. After repointing – East wall in Terrace Building 1 (July 2006)

Figure 51. Section of the east wall in Terrace Building 1 after repointing and reburial

Figure 52. South wall in Terrace Building 1 after installation of pilot program and reburial

Figure 53. Terrace Building Complex from southeast – after reburial
2006 Field Report – Terrace Building 2

Section 1: INTRODUCTION

The Terrace Building Complex at Gordion, extensively conserved and stabilized since its time of excavation due to the instability and splaying of its walls that resulted from massive destruction by the fire in the early Phrygian Period dated to 800 BC, was the second focus of the 2006 field program. Terrace Building 2 (TB-2) was selected as the pilot area during this field season, due to its proximity to the visitor circuit and visibility, for designing, installing, testing and monitoring long-term solutions for wall stabilization and reburial at the Terrace Building Complex. A description of the Terrace Building Complex since its time of excavation, past conservation interventions in this area, and the methodology applied in this field program and its results will be provided in this report.

In 1999, architectural conservator Mark Goodman stabilized most of the walls in the Terrace Building Complex by placing sandbags along the walls’ foundations and mud-clay capping with plastic sheeting on top of the walls. The sandbags provided structural support and the sand remained in place seven years after their installation. In addition, the clay capping provided a moisture barrier. However, this intervention, intended as a short-term solution, was subject to weathering and required a high level of maintenance. It was therefore decided to implement a longer term solution that would provide protection and stabilization for the walls, as well as improve the legibility of the Terrace Building Complex from the visitor circuit above.

The objectives of the field work were to assess the condition of the walls of a selected area since the stabilization of caps and placement of sand-bags in 1999, compare three methods of reburial by monitoring temperature and moisture using data loggers over a one year period, and design and implement stabilization and display for that area with partial reburial and repointing, or full reburial. The south wall of TB-2 was selected as the pilot area for testing and monitoring alternative methods for reburial and “soft wall capping.” In three areas, a data logger, recording temperature and moisture four times a day for a one year period, was placed and a different type of wall covering and capping installed in each area. Each of these reburial methods will be re-assessed after one year, in July 2007.

Section 2: ARCHITECTURAL DESCRIPTION

2.1 Terrace Building Complex

The majority of the Terrace Building (TB) Complex has been well excavated and documented to provide a thorough understanding of the structures’ construction, materials, and functions. Excavations started at the TB Complex in 1956 under Rodney Young, continued until the early 1970s, and resumed under Mary Voigt in 1986. The entire site was excavated except for three anterooms.

Publications pertaining to the excavations of the Terrace Building Complex and/or that provide architectural descriptions include the American Journal of Archaeology, Gordion Field Notebooks, and more recent publications from The Archaeology of Midas and the
Phrygians - Recent Work at Gordion in particular Brendan Burke’s “Textile production at Gordion and the Phrygian Economy”.  

The Terrace Building Complex was constructed on a raised terrace approximately 1 meter high behind Megara 1 - 4 (please see site plan below and in the appendix). The complex consists of eight rooms or workshop units (Terrace Building or TB 1 – 8) that are connected linearly with a shared side party wall between each unit (except for the outer walls of the two end buildings) and with a common rear wall. Each unit is identical in plan, proportions and orientation. Each megaron-type unit measures approximately 11.50 meters in width and 13.00 meters in length and has a southwest-northwest orientation. The total length of the TB Complex measures about 105 meters from north to south. On the west side of the Terrace Building Complex, there is a shallow anteroom joined to each unit, approximately 7 meters deep, totaling the length measurement east to west for each unit to about 20 meters.

Figure 1. Site Plan

At the time of excavations from 1956 to 1968, the height of the masonry walls was roughly calculated from the remaining architectural elements. The wall included the following:

1. Three sets of four stone courses, each about 80 centimeters high, separated by two timber courses, each about 20 centimeters thick and backed by rubble, bringing the walls to about 2.80 meters high.

The walls were built with stone ashlar, mostly consisting of sandstone and limestone, and rubble fill. Above this wall section there was most likely a leveling course of timbers on which rested a superstructure of sun-dried mud brick. It is probable that the inside level of the wooden galleries started at the change in the wall’s construction from masonry to mud brick and surrounded the rooms on three sides.

Details from the complex’s construction indicate that the Terrace Building Complex was planned and built all at once as an important public building and center used for weaving and cooking. The building as a whole provides evidence of a well developed “centrally organized textile industry ... a major feature of the Phrygian Royal economy at Gordion and an important resource for the Phrygian elite during the Early Iron Age (c. 9th century)”. Revealed during excavations, the main units and the eastern series of units (also referred to as the anterooms) had at their east end a grinding-stand for flour making with multiple sets of grindstones. The found artifacts also indicate that the production of bread, including grinding, kneading, and baking process, occurred in the TB complex. The anterooms, with a single stepped entrance, often had cooking installations. Each unit also contained vast numbers of pottery vessels used for the storage of liquids and other kinds of cooking. In addition, a large number of artifacts including unbaked clay loom weights, spindle whorls, and other textile equipment excavated in the TB units indicate that the units were used for textile production.

2.2 Terrace Building 2 (TB2)

Terrace Building 2 (TB2) is the second room in the linear sequence of the rooms forming the Terrace Building Complex, starting from the south end. The east wall measures 11.50 meters from corner to corner, the north wall measures 13.00 meters, the west wall (including doorway) measures 11.50 meters, and the south wall measures 13.10 meters. The unit’s walls measure 1.30 meters thick and, as discussed previously in the Architectural Description, the walls were built with stone ashlar and rubble fill, mostly consisting of sandstone and limestone. In most places, the walls have split down the middle and the faces lean out in either direction. They were bedded on wooden beams at or just below floor level. Their uniform height is due to the presence of horizontal timbers laid in the wall faces at that height.

The main room was entered through the anteroom and wide doorways located on the west side. The wall ends beside the doorways show beds in which the wooden jambs framing the doors once stood. The main room had four oblong post-holes in the floor along the north and south sides and a single post-hole at the center of the east side (please see following figure 2).

---

2 B. Burke, 69.
Figure 2. Plan of Terrace Building 2. Sketch from Gordion Field Notebook 100, C.H. Greenewalt and J. McLaughlin 1961.

The dimensions of the holes suggest wooden posts measured about 12 by 20 centimeters on a side. The corner post was larger and L-shaped and the central eastern post was larger than the side posts. These freestanding posts were paired with another set standing immediately in front of the wall-face. These posts may have been pegged to the horizontal timbers in the wall faces.

The interior of the main room had a wooden gallery running around three sides (north, east, and south walls) partly supported on posts independent of the building construction and in part against the posts which helped support the roof. A hearth, found near the center of TB2, was independent of the wooden galleries. Most likely there was an outlet in the roof for the hearth. The roof may have been constructed of heavy timbers covered by reeds and an outer layer of clay. Most probably the roof was flat with a gentle slope towards the east end and a central opening/outlet for the hearth covered by a louver. The only source of light for the room would have been through windows in the east wall supplemented with the central opening in the roof.

Section 3: CONSERVATION HISTORY

3.1 Previous interventions for Terrace Building Complex

The Terrace Building Complex has been extensively conserved and stabilized, in comparison to other structures on the Citadel Mound, since its time of excavation due to the instability and splaying of its walls that resulted from the massive destruction done by the fire in the Early Phrygian Period dated to 800 BC (M. Voigt 2005, p. 27).\(^3\) In the late 1980s and

1990’s several interventions were carried out to stabilize the Terrace Building and protect its walls from further deterioration. A summary of the interventions carried out to date are provided below, specifying the entire TB Complex or just TB2.  

1955-1968: During the excavations of the Terrace Building Complex, the walls were found to be unstable. Therefore, conspicuous voids created by the destruction of the timber stringcourses were packed with loose rubble. Rubble and fallen ashlars were also stacked against the splayed walls to provide support. These measures, while not systematically applied, provided some degree of protection. In time, many of these buttresses fell apart and eroded away.

1989, 1996: A temporary cap was applied for protection of the relatively well preserved walls of TB-1 and 2. These caps consisted of earth-covered nylon sheeting held in place by small stones; a preventive measure that provided protection against freeze-thaw damage and held up surprisingly well. This capping was also intended to mimic the appearance of the walls as they were freshly excavated. It was decided that this type of capping would be applied to the rest of the site due to its effectiveness, low cost and visual compatibility. It was also decided that a similar technique could be applied to other significant site features such as site paving for their protection during the winter months and “seasonal exhibition.”

1993: A plan for the reconstruction and interpretative presentation of one terrace building unit, TB-4, was developed and implemented. This plan involved the documentation, disassembling, and reconstruction of the masonry walls, installation of protective concrete capping on reconstructed walls, and the development of an interpretive program for presenting the interior features of the building. The scope of work completed in 1993 included: (1) trial and selection of materials and restorative techniques, and (2) restoration of the western crosswall and attached section of the antechamber.

1994: Reconstruction work continued in TB-4. Unstable masonry of the south wall was disassembled, reconstructed, and capped with concrete. In addition, many freshly quarried stones used in the reconstruction work in 1993 were found to be deteriorating rapidly, and therefore they were removed, replaced, and recapped (the western crosswall and antechamber).

1998: Unstable portions of the east and west partition walls of TB-4 were disassembled and reconstructed following the procedures established in 1993. During disassembling of the east wall, a central section containing significant portions of original plaster was found to be relatively stable. This section, unstable structurally due to its original splay, was retained in situ and bonded into the reconstructed wall using tensile reinforcement.

After evaluation of the aesthetic impact of concrete capping, it was decided to experiment with a new technique of “raised core capping.” This technique involved the setting of core masonry over the top level of the wall with stones positioned to provide drainage through open joints of the top veneer course. The East partition wall was finished with raised core capping, while the West wall, containing plaster in situ, was capped with mud isolated concrete. In addition, chalky limestone ashlars quarried in 1993 were laid over

---

the central portion of the West wall. These stones were bedded in lime mortar amended with pozzolanic additive—crushed, low-fired ceramic obtained from a local brick factory used in making horasan. The mortar was also mixed with a small percentage of grass ash to improve water retention of the mortar during the hot summer season. The introduction of raised core capping and mortar with brick dust and grass ash was limited to allow for careful evaluation of this new technique.

1999: Work continued in TB-4. The removal of the concrete capping from the western crosswall, partially reconstructed in 1993, revealed structural problems within the wall. It was therefore decided to disassemble and reconstruct the western crosswall according to its original configuration. The exposed portion of the west wall of the anteroom was also cleaned, consolidated and core capped. The eastern crosswall was buttressed with loose rubble and work deferred until the following season.

The raised core capping applied in 1998 had passed the winter with minimal damage. It was decided to remove all the cement caps in TB-4 and replace them with raised core capping. This capping allowed the walls to be raised to post-excavation height and highlighted the masonry walls and construction technique.

The horasan mortar had also performed well, allowing for the elimination of white Portland cement (WPC) from the reconstruction mortar. Hydrated lime (HL) was mixed with water, soaked for ten days and used as a lime putty. The lime mortar was mixed in a rotary mixer adding gradually the sand, lime, crushed ceramic, and grass ash.

The reconstruction technique for TB-4 was also refined. After documentation, the masonry was disassembled course-by-course, salvageable stones labeled according to their original position within the wall, and unsalvageable stones characterized and replaced with similar stone. Temporary mud coating was applied to the wall face before laying each course in order to facilitate the removal of mortar stains.

The mortar bed was recessed approximately 4 cm. to spread under the weight of the laid courses to 1-2 cm. of the wall face. After the mortar stiffened to thumbnail consistency in a day or so, the joints were compacted and scraped to expose the aggregate and provide a weathered appearance. The color of the mortar was similar to but could be distinguished from the original earthen mortar.

In addition to working on TB-4, conservation efforts were expanded towards protecting additional sections of the Terrace Building as a whole. These activities included:

1. Unstable walls in TB-1, TB-2 and TB-8 were buttressed with burlap sandbags.
2. The southwest section of the Terrace Gate Building, constructed of exposed mudbrick, was backfilled with geotextile and sand, and encased in a supportive sandbag wall.
3. The upper courses of TB-1 and the south wall of the Terrace Gate Building, including the backfilled mudbrick wall, were covered with protective nylon caps similar to those installed in 1989, but bedded and covered with sand.

---

5 Horasan is a term used in Turkish for mortars and plasters containing ceramic or brick dust.
6 The grass ash was obtained by burning site vegetation cleared annually.
Burlap sandbags were used to complete the stabilization of the Terrace Building Complex as a temporary measure. Sand was first placed against the bases of the walls, sandbags built up against the face of the walls, and covered with geotextile coated with a clay and acrylic emulsion slurry.

The technique of earth/polyethylene capping applied in 1989 was used to cap all the exposed walls using local clay deposits, and any sand used previously for capping replaced with earth. The caps were also anchored with different colored stones to reflect the stone colors of the walls below.

Figure 3. Section illustration of earth/polyethylene capping installed on Terrace Building Walls. Figure courtesy of Mark Goodman “Interpretive Stabilization at Gordion, an Iron-Age City in Anatolia” in Conservation and Management of Archaeological Sites 5, no. 4, 2002

Figure 4. TB Complex from SE, 1998
Photo courtesy of Mark Goodman
3.2 Previous interventions for TB-2

During excavation in 1961/1962, voids created by the destruction of timber were packed with loose rubble. Rubble and fallen ashlars were stacked adjacent to splayed walls to buttress.7

1. Temporary cap protection was applied on the walls of TB-2 consisting of earth-covered nylon sheeting and small stones in 1989 and 1996. They were intended to provide protection against freeze-thaw damage with minimal aesthetic impact and mimic the appearance of the walls as they were excavated.
3. Technique of nylon and earth capping used to cap all exposed walls in 1999. Local clay deposits were used for capping.

3.3 Previous conditions for Terrace Building 2

At the time of excavation, the south and east wall elevations had pronounced leans. The south wall face leaned over to the north and the east wall face leaned over to the west due to weakening of the wall’s structure.8 These leans were most likely due to the collapse of the walls at the time of the destruction of the structure in ca. 800 BC. The walls splayed outward due to the weight of the superstructure falling on top of the walls. This condition was therefore reflected in the pronounced leans of the walls at the time of excavation in 1961/1962.

There was also a considerable amount of plaster remaining on the walls at the time of excavation, described in detail in the excavation field notebook. A few pieces of charred (beams, posts or rafters) wood rested on the floor in the Southeast quarter. Burnt wood was found in each post hole.

Section 4: OBJECTIVES/GOALS

The objectives of this season’s fieldwork at TB-2 were three-fold: (1) to assess the conditions of its walls since stabilization of caps and placement of sandbags in 1999, (2) compare three methods of reburial with monitoring of temperature and moisture using data loggers over a one year period, (3) design and implement stabilization and display for TB-2 with partial reburial and repointing (when necessary) or full reburial.

Section 5: METHODOLOGY

Terrace Building 2 (TB2) was selected as the pilot area for designing, installing, testing, and monitoring longer-term solutions for wall stabilization in the Terrace Building Complex. The south wall of TB-2, selected for testing and monitoring reburial and capping methods, was the focus of the field work, while the remaining walls of TB-2 were reburied and repointed where necessary. Additionally, the walls in TB-1 and the south wall in TB-3 were reburied to help determine the aesthetic impact of reburial at the Terrace Building Complex from the visitor circuit route.

In 1999, architectural conservator Mark Goodman successfully stabilized the walls in the Terrace Building Complex, except TB4, by placing sandbags along the walls’ foundations and by placing mud-clay capping with plastic sheeting (polyethylene) on top of the walls. The sandbags provided structural support and the sand remained in place, even seven years after they were installed. Additionally, the clay capping provided an efficient moisture barrier. This intervention was intended as a short-term solution for wall stabilization in the TB complex. It was decided to implement a longer-term solution due to the degraded felted geotextile fabric placed over the sandbags, the bad condition of the current sandbags, and the high level of maintenance required to maintain and/or replace the sandbags and the slurry coat applied over the felted geotextile fabric. Furthermore, the degraded sandbags decreased the aesthetic experience at the Terrace Building Complex and at the entire site with the torn sandbags adding to the sense of neglect.

It was therefore decided to implement a longer-term solution due to the degraded felt geotextile fabric placed over the sandbags, the bad condition of the current sandbags, and the high level of maintenance required to maintain and/or replace the sandbags and the slurry coat.

9 The plaster remains found in TB-2 are described as follows: “In the South-East quarter, the South wall plaster was well preserved except for the topmost 30 cm. or so where it was mostly missing. In the Southeast quarter the East wall’s plaster was likewise well preserved, except in two areas: (1) on the wall from a joint 1.60 m. from the South wall base up to 2.80 cm from the South wall base, (2) from 4.00 m. to a point 6.75 m. from the South wall base. In these two areas the plaster was mostly missing. In the area from 4.50 m. to 5.75 m. from the South wall base the preservation was particularly bad, the plaster being totally gone from top to bottom of the East wall” (Gordion Notebook 100, McLaughlin, Greenewalt-NB 100 (1961/1962), pp. 67-68.
applied over the felt geotextile fabric. Furthermore, the degraded sandbags decreased the aesthetic experience at the Terrace Building Complex and at the entire site with the torn sandbags adding to the sense of neglect.

The following steps were taken:

I. Documentation

II. Condition Survey

III. Treatment and testing program for the south wall with complete reburial and capping

IV. Stabilization program for remaining walls in TB-2, TB-1, and the south wall in TB-3 with partial reburial and repointing or complete reburial

5.1 Documentation

Before initiating any treatments, all interior and exterior walls were photographed. The digital photographs were rectified and montaged when necessary. The south wall in TB-2 was chosen as the pilot area for the monitoring program. Therefore, more detailed photography was taken of the south wall. For this elevation, full frontal photographs were taken two meters from the facade.

For the south wall only, detailed photographs were taken after removing the sandbags for the testing program. The remaining walls were photographed with the sandbags in place and/or immediately before reburial with top layer of sandbags removed (the timing of the work sometimes did not allow for proper photography due to the intense sunlight during working hours). Generally, photography was done in the early morning or later afternoon.

Measured drawings were completed for three sections of the south wall. The drawings include elevations, sections, and schematic sketches indicating the forty-five degree slope of the reburial and the locations of data loggers with attached temperature and moisture probes.

5.2 Condition Survey

Photographic documentation was used to conduct the condition survey for the south wall. In preparation for the monitoring program, the south wall was divided into three main sections with data loggers and two smaller sections with no data logger between each main section (please see figure 6 below).
The three main areas with data loggers are identified as:

Section I – south-east corner of the wall
Section II – central area of the wall
Section III – south-west corner of the wall

Figure 6. Plan of south wall elevation divided into sections used for condition survey and installation of pilot program

Figure 7. South wall of TB2 - before
Only the three main areas with the data loggers were surveyed.

Each section was photographed individually. The photographs were rectified and montaged (when necessary) and used to complete the condition survey. The condition survey involved measuring the wall sections’ dimensions including width, length, and height and measuring the wall’s tilt using a plumb line. The condition survey assessed the type of stone(s), the condition of the stone (poor, fair, good, or excellent), the number of courses, presence of salts, location of entire stones, and location(s) of the probes for the monitoring program (please see scanned condition surveys in the appendix).

After removal of the sandbags, salts were present on the stones’ surface. Future actions for this project will therefore involve testing the soil, sand, and local water used in conservation interventions for salts and pH. The testing for the soil will be preformed at METU (if possible) and at the University of Pennsylvania Architectural Conservation Laboratory. Samples were collected for testing. The water will be tested next field season.

5.3 South Wall - Testing program for reburial and capping with alternative wall coverings

The south wall of TB2 was selected as the pilot area for testing and monitoring alternative methods for reburial and soft wall capping. In each main area with a data logger (Sections I – III), a different type of wall covering and capping were installed. Due to the
stone’s poor condition and the necessity to determine the efficacy of reburial for preserving the stone walls, the test areas were reburied completely. Reburial involved several well defined steps, as explained below, creating a forty-five degree angle slope. After creating the slope, different plantings were placed on the wall’s capping and on the slope for sections II. Transplanted plants were placed on the capping for section III only; no plantings were placed on the slope. Soft wall “capping” is used in this report to describe placing a cap of soil and turf (or other vegetation) on top of ruined walls or remaining archaeological fabric.¹⁰

The steps for the testing program on the south wall in TB-2 included the following:

1. Wall Preparation: Gradual removal of sandbags and sand supporting the south wall for the main areas only with data loggers (the sand was saved for future use in the wall reburial program). The three main areas were cleared first for documentation and condition surveying and the two smaller areas remained in place for structural support. The two smaller areas were reburied at a later point (only the top row of sandbags were removed).

2. Cleaning: The exposed wall areas were then cleaned with soft bristle brushes, pointers, and trowels in preparation for the testing program.

3. Documentation and Surveying: The wall sections were photographed and surveyed (please see above Documentation and Condition Surveying).

4. Ground and Drainage Preparation:
   - Level ground adjacent to the wall
   - Place pebble/stone gravel at base of wall to provide proper drainage (“French drain”)
   - Use pebbles/stones available at the site (exterior of TB1)

* The amount of gravel placed at the base of the wall measured within a 6 inch high and 20 inch long slope area.

15 cm

Figure 9. Diagram of slope created for “French drain”

5. Installation of Different Wall Coverings and Data Loggers (HOBO Micro Station) for the Reburial Testing Program:

   a. Different types of geotextile fabric were placed between the wall and the soil/sand mixture in Sections I – II

¹⁰ Heather Viles and Chris Wood, “Evaluating the role of soft wall capping in conserving ruins,” The article was given to the authors and it remains undetermined if the article has been published. A second article pertaining to this subject has been located and its citation includes the following: Heather Viles and Chris Wood, “Soft Wall Capping Experiments,” English Heritage Research Transactions 2 (2002), 59 – 73.
i. Section I: White thermal geotextile fabric (used previously for wall capping and sand bag project in 1999) *Large rolls were purchased locally at a nursery near Anakara.*

Figure 10. Section I – installation of “French drain”  
Figure 11. Section I – Kelly Wong removing clay capping  
Figure 12. Section I – Frank Matero packing soil mixture  
Figure 13. Section I: after installation of data logger  
Figure 14. Section I – after reburial
ii. Section II: Typar (a grey semi-permeable geotextile fabric)

Figure 15. Section II – installation of French drain
Figure 16. Section II: data logger set up in Pelican case
Figure 17. Section II – placement of soil
Figure 18. Section II – during slope installation
Figure 19. Section II – after installation of monitoring program and reburial
iii. Section III: No protective covering between the wall and the soil mixture used for the reburial

Figure 20. Section III – before

Figure 21. Section III – during installation data logger for slope

Figure 22. Section III – during installation

Figure 23. Section III – after installation and reburial

Figure 24. Section III – during rain July 3 2006
b. Placed the outdoor HOBO Micro Station data loggers in a waterproof Pelican case on a level bed of 1:1 soil to sand mixture, each data logger programmed to measure soil moisture and temperature 4 times a day at six hour intervals for one year (the data loggers started measurements on June 28, 2006).

![Data logger installed in slope](image)

Figure 25. *Data logger installed in slope*

6. Installation of metal rod markers in order to identify placement of data loggers for future removal and retrieval of data in one year.

![Metal rod marker](image)

Figure 26. *Section I, south wall in TB2*

7. Placement of 1:1 soil/sand mixture to create forty-five degree slope for sections I – III.

8. Completion of capping test program on the south wall (pilot area)
a. Removal of clay top
b. Division of top wall capping into four areas with three areas containing data loggers (parallel to three sections created for the slope) and placement of different protective fabrics between the capping material and stone fabric

The four areas on the wall capping include the following (please see appendix listing different types of plantings placed in the wall capping):

i. Continuous rubble/stone covering
ii. Mudballs planted in 5 – 10 cm layer of soil only placed above original clay capping
iii. Seeds only
iv. Transplanted poa turf

![Diagram showing the four areas on the wall capping]

Figure 27. South wall in TB2

The three areas being tested include the following:

i. Section I: White geotextile fabric
ii. Section II: Grey typar geotextile fabric
iii. Section III: Polyethylene sheeting (already in place from Mark Goodman’s clay capping treatment 1999)

- Placement of outdoor HOBO Micro Station Data Loggers for monitoring of area below the wall cappings
  - Placement of data loggers in the assigned slope
  - Placement of probes under the capping materials (including the geotextile fabrics or polyethylene sheeting material)
d. Straightening of stone lip perimeter (to improve view from top of escarpment)
   • Replacement of stone (if necessary)

9. Completion of slope with 1:1 soil to sand mixture
   • Rebury the wall using a forty-five degree slope (please see section below describing creation of forty-five degree slope)
   • Make sure to tamp down the soil/sand mixture and sprinkle with water to insure the slope remains compact
   • Last layer on the slope was only 5 – 10 cm of soil to insure proper planting of seeds (Section II – \textit{Taeniatherum}).

10. Placement of plantings on the slope
    a. Each slope area with a data logger contains either no plantings or different type of plantings

    i. Section I – no plantings
    ii. Section II – half seeds, second half mudballs with seeds
    iii. Section III – no plantings

Figure 28. \textit{Section II – after watering newly planted seeds and mudballs}
\textit{Mudballs on left side and seeds on right side of central darker area on slope}
11. Plant mudballs on ground adjacent to slope at Section II

![Mudballs planted in the ground at the base of slope Section II – South wall in TB2](image)

**Figure 29. Mudballs planted in the ground at the base of slope Section II – South wall in TB2**

### 5.4 Stabilization and Reburial Program for Walls in TB2 (North, East, West Walls, the Anteroom), TB1, and the south wall in TB3

Stabilization interventions involved repointing and/or replacing decayed stones. The remaining walls in TB2 (north, east, west, and in the anteroom), all the walls in TB1, and the south wall in TB3 were completely or partially reburied depending upon the stones’ conditions.

The steps for stabilization and reburial included the following:

1. **Sand Bag Removal:**
   - Remove top row of sand bags
2. Sand Bag Upkeep and Maintenance:
   - Maintain and leave lower two rows of sand bags (depending upon the bag’s condition)

3. Stone Cleaning and Preparation for Repointing:
   - Determine if the stone is in good enough condition to be exposed and repointed
     If stone is in good enough condition, then use a soft bristle brush, pointer, and/or trowel to dry clean before repointing.
   - Use water to clean out the debris, dust, etc. from cracks and joints
   - Make sure stone and joints are moist before placing mortar

4. Repointing:
   - Test mortar samples to determine compatible mortar mixtures that match the stone’s color using two different formulations.
     
     i. The first formulation consisted of a 1:3 (lime to aggregate) with the aggregate consisting of 2 parts sand and 1 part brick dust.
     
     ii. The second formulation consisted of a 1:3 (lime to aggregate) with the aggregate consisting of 1 part sand and 2 parts brick dust.

   - Decided to use a 1:3 (lime to aggregate) mortar mixture for repointing, the lime is HHL Lefarge and the aggregate consists of 2 parts sand and 1 part brick dust.
   - Please see list of materials and supplies used for repointing in the appendix
   - Use a natural sponge with 5% formic acid to expose aggregate for a more natural finish
   - Remove excess mortar immediately to prevent any staining or damage to original fabric.
   - Use 5% formic acid to remove any remaining dried mortar (if necessary)

5. Reburial:
   Reburial (both partial and complete reburial) involved creating a forty-five degree slope, which was done by measuring the height of the wall and by measuring that same distance from the wall’s foundation outwards on the level ground (theoretically creating a right triangle with a ninety-degree angle at the corner where the wall foundation meets the level ground and an isosceles triangle with two equal sides along the height of the wall and along the ground with the remaining two angles equaling forty-five degrees).

Figure 30. Forty-five degree angle slope created for reburial program
Reburial involved using a one to one mixture of sand and soil. The sand was reused from the removed sandbags. The sieved soil was taken from the northeast section of the citadel mound (as advised by Kenneth Sams and please see below photograph). Alternating workers at the site completed the reburial; usually 2 - 3 workers were available.

Figure 31. Mixture of sand/soil at TB2

Figure 32. Sieved soil used for reburial.
The soil is located on the eastern side of the citadel mound.
Section 6: CURRENT CONDITIONS/OBSERVATIONS

The current condition of the walls in TB2 was determined to be fair based on comparisons between past and current photographs and on the condition survey conducted for the south wall only. The walls continue to require structural buttressing and certain stones can not remain exposed due to their advanced decay and therefore call for protective measures for their preservation.

Overall, the walls in the entire Terrace Building Complex are in poor condition due to the fire that occurred in 800 BC, abandonment after the catastrophic fire, subsequent burial with three to five meters of clay fill, and later exposure after archaeological excavations conducted from the 1950s into the early 1970s. The timber laced masonry construction of the Terrace Building Complex was badly damaged in the fire when horizontal stringcourses combusted which caused the removal of key structural elements within the walls.\footnote{Goodman, Mark. 2002. Site preservation at Gordion, an Iron Age city in Anatolia. \textit{Conservation and management of archaeological sites} 5 no. 4: 200.} Subsequently, the walls splayed outwards and collapsed. The intense heat from the fire additionally caused the limestone masonry to crack and partially calcine. After the fire, the Phrygians eventually buried the ruined structures under several meters of clay fill and rebuilt over the site. Later excavations unveiled the structurally unstable walls and supportive buttresses were installed in certain areas. Some walls that were not supported eventually collapsed and the tops of the walls were left exposed and unprotected.

The sandbags and capping installed from 1999 to 2004 successfully provided structural support for all the walls in the TB Complex and protection of the walls’ tops from extreme weather conditions of the region (in particular significant freeze/thaw cycling in the winter months); however, certain stones continue to decay due to their poor condition. The removal of the sandbags and sand fill in TB-2 during the summer of 2006 revealed that the walls were in relatively good condition except for efflorescence in the stones after wetting for repointing, especially in the north wall of TB-2. Only certain stones were deteriorated due to their natural susceptibility to decay. Open joints and missing stones were existent prior to the placement of sandbags, as seen from Mark Goodman’s photographs taken during the installation of the sandbags.

The condition survey conducted was done as preparatory work for the south wall installation and testing program using alternative materials for reburial and for wall capping. The condition survey assessed the type of stone(s), the number of courses, presence of salts, location of entire stones, and location(s) of the probes for the monitoring program (please see results of condition survey). The survey process allowed for the identification of key conditions including cracking, thin versus thick detachment, complete loss, deteriorated mortar, salts, and crusts (please see photographs). These conditions were found predominantly on all three areas surveyed and therefore were not specified individually on the photographs used for the survey.

Cracking for this condition survey is defined as a fracture without complete separation of parts and/or a fracture that might only appear on the surface and may be only a superficial break. Thin detachment is a break that measures between 1 to 4 centimeters from the surface and thick detachment is a break greater than 4 centimeters from the surface. Loss is defined as missing stone(s) and was visible predominantly in the central area (Section II).
Deteriorated mortar was prevalent in the central area (Section II); however, it remained undetermined if the mortar was original to the wall’s construction and further testing would be needed (mortars samples were collected and were shipped to the University of Pennsylvania Architectural Conservation Laboratory). Salts were apparent on the stones’ surface after removal of the sandbags, further testing will determine the type of salts (presently, it is assumed that they are chlorides). The orangish hard crusts found on certain stone surfaces remained unidentified, it is possible they are remains of biogrowth. These crusts are only superficial, and do not contribute to the advanced decay of the stones.

As indicated in Mark Goodman’s field notes and photographs, certain sections of the walls were rebuilt and therefore are not original to the TB Complex construction. The west
wall entranceway (specifically the northern section) between the anteroom and the main room were rebuilt, as well as the east wall.

During the field season of 2006, certain areas were noted to be structurally unstable. Before reburial, the northwest corner of TB2 appeared structurally unstable since it was leaning inwards towards the interior of the unit. Complete reburial has provided sufficient structural support. The adjacent scarp jutting towards the north wall in the anteroom should be noted and considered in future actions addressing the advanced erosion of the escarpment.

Section 7: TREATMENT PROGRAM

The treatment program for TB-2, as discussed in Methodology, involved documentation, a condition survey for the south wall only, development and installation of pilot area on the south wall testing alternative reburials and wall cappings, and stabilization and reburial for the remaining walls in TB2 (including its anteroom), TB1, and the south wall in TB3. The following section of the report will list details explaining the location of specific treatments, the amount of time required for completion, the amount of people involved, additional supplies used, and important steps completed that were not listed under Methodology.

Due to the additional time available at the end of the field season, extra measures were taken to replace damaged geotextile fabric and to reapply a mud slurry over weathered geotextile fabric not completely damaged covering sandbags in the remaining TB units and outside the TB Complex. Additionally, animal holes were filled in Megaron 1 (located under the only standing wall between Megaron 1 and Terrace Building Complex) with stones and soil.

Figure 39. West wall in Megaron 1 – Animal burrowing holes

Figure 40. Hikmet filling in the holes with stones
The following treatments were completed during the field season of 2006 in the order of sequence listed below:

7.1 Documentation

Photographic documentation occurred throughout the season. Before and after photographs were taken for each wall treated, as well as photographs of the different treatments. Before and after photographs were taken early in the morning or later in the afternoon. One person was responsible for the photograph documentation during the season. Certain photographs from the beginning of the field season are not in focus due to a camera damaged during transport from the United States to Turkey. This was noted early in the season and a different camera was used for documentation. These photographs are burned onto a DVD and will be given to Frank Matero (University of Pennsylvania) and to Evin Erder (METU).

Measured drawings of the three different sections being tested for the south wall pilot program were completed. The measured drawings include elevations, sections, and a diagram showing the data logger set up (including locations of the moisture and temperature probes). The drawings were completed during the afternoons and any time workers were not available at the site for the TB project. Sarah Cleary and Evin Erder completed the drawings.

7.2 Condition Survey

The condition survey was done for the south wall only in TB-2. The condition survey was done as preparatory work for the south wall testing program. The results of the condition survey are discussed in Current Conditions/ Observations. Two people (Sarah Cleary and Evin Erder) completed the survey in one afternoon. The condition survey was completed immediately after removal of the sand bags (three different sections surveyed). The condition
survey was done on printed color photographs (placed in plastic sleeves) and marked with sharpie pens. The results of the condition survey have been scanned and copies will be attached with this field report and given to Frank Matero and Evin Erder.

7.3 Pilot Program for the South Wall in TB2

The pilot area installed on the south wall is testing alternative materials for reburial and capping (please steps involved in Methodology and list of different materials in appendix). The results from the pilot area testing program and the visual impact from the visitor circuit route on the escarpment will help determine the efficacy of reburial and capping for the preservation and interpretation of the entire TB Complex. Two workers (Hikmet and Salem) completed the installation in two days while Evin Erder supervised and Sarah Cleary prepared the data loggers for installation at the excavation house. The software provided with the HOBO data loggers is stored at the Gordion excavation house (inside the HOBO Micro Station binder left inside the architectural conservation cabinet). Any PC laptop with JAVA Runtime can download this software. Currently, the software is loaded on a Dell PC laptop located at the University of Pennsylvania Historic Preservation Department and on Evin Erder’s laptop. Additional hardware (Keyspan Serial Adapter, USB Serial adapter, and wires) needed to download the data has been left at the excavation house in a box labeled “HOBO Micro Station” located under the architectural conservation desk area. Further inquiry concerning this pilot program will be done during the year, in particular interviewing the authors of the case studies used as models for this pilot program (Heather Viles and Chris Wood), environmental conservator Steven Weintraub, and if possible a soil scientist.

Figure 42. Evin Erder placing transplanted plants (Poa)  
Figure 43. Hikmet watering the newly transplanted plants  
Figure 44. Sarah Cleary placing mudballs on wall capping
7.4 Stabilization and Reburial of Walls in TB2, TB1, and the south wall in TB3

Repointing:

The exposed top two courses of the north wall in TB-2 required repointing after determining that the stones were in stable enough condition to be left exposed. The same procedure was used for repointing this wall section as discussed above in Methodology. After repointing, efflorescence did appear due to the wetting required during the process. With four people working on the repointing, including Sarah Cleary, Evin Erder, Gulsun Ozkan, and Kelly Wong under the direction of Frank Matero, the work was completed in a day and a half including instruction and preparation of the wall prior to repointing.

In TB-1, a section of the east wall required repointing after it was decided to leave the upper courses exposed. Sarah Cleary, Evin Erder, and Gulsun Ozkan completed this section of repointing. Issues did occur concerning the absorption of lime due to the porous condition of the stones. After repointing, the stones were washed immediately and repeatedly with natural sponges or 5% formic acid (if necessary) to insure that no lime or mortar mixture remained on the stones’ surface.
Figure 48. East wall in TB1 – before repointing

Figure 49. Evin Erder and Gulsun Ozkan repointing (July 2006)
Figure 50. After repointing (July 2006)

Figure 51. Section of the east wall in TB1 after repointing and reburial during the 2006 field season.
Reburial:

The south wall of TB-2 was completely reburied after installation of the data loggers.

![South wall in TB1 after installation of pilot program and reburial.](image)

The north wall in TB2 was partially reburied after repointing, exposing the top two courses of the wall, due to the good condition of the stones. The top row of sand bags were removed and the lower two rows of sand bags remained in place at the wall’s foundation due to their additional structural support and due to the additional amount of labor involved in their removal. The area in the northwest corner was completely reburied considering the pronounced lean of the corner (as discussed above in *Current Conditions/ Observations*). The partial reburial of the north wall took less than one day with two workers.
The east wall (less than half of the wall) in TB-1 was partially reburied (please see above photograph) leaving the upper courses exposed. The remaining half of the wall was completely reburied.

The remaining walls in TB-2, including the east and west walls and the walls in the anteroom, were reburied (please see before and after photographs in appendix). Again, a forty-five degree slope was used for the reburial. The sand soil mixture was shoveled over two layers of remaining sandbags. The reburial of the remaining walls in TB2 required two
workers and was completed in less than one day. Certain sections of the walls were not completely reburied and were left exposed; in particular the south wall in the anteroom. Future work at the TB complex should decide whether or not it is necessary to repoint this section of the wall.

After completion of the TB-2 unit, it was decided to rebury the opposite sides of the north and south walls of TB-2 to fully understand the visual impact of reburial from the visitor circuit route. Therefore, the north wall in TB-1 and the south wall in TB-3 were reburied. The remaining wall sections in TB-1 were reburied, including in the anteroom. Only the south wall in TB-3 was reburied. The same steps were followed for the reburial as discussed in Methodology. Certain sections of the walls were not completely reburied and were left exposed; in particular the south wall in TB3 has one course left exposed. The next field season should plan for the repointing of this wall section (if considered necessary).

Section 8: CONCLUSIONS & RECOMMENDATIONS

The reburial of the walls of TB-1, TB-2 and South wall of TB-3 was completed during this season. Three factors were critical in this process: (1) removal of the sandbags to assess the conditions of the walls seven years later and determine their efficacy, (2) testing of three alternative reburial and four alternative capping methods for the walls as a more permanent solution for their preservation and improved legibility, and (3) reburial of the interior walls of the main room and anteroom of TB-1 and TB-2 and the South wall of TB-3 to assess the legibility of these rooms from the visitor circuit.

The effect of the three types of reburial and the four types of capping both associated with different types of plantings can only be determined after a year when the data loggers will be removed and the results analyzed. Nevertheless, such methods of reburial and capping, whether with or without stones or with certain planting should improve the legibility of the walls while providing them with protection from further decay. The reburial of the walls of the three rooms have allowed for an assessment of the visual impact of this reburial method and its effect on the legibility of TB-2 from the visitor circuit above.

The recommendations for this project have been divided into short term, medium term, and long term. They include the following:

Short Term (within one year):

Pilot Program on the South Wall in TB2 –

- Contact the authors of the case studies used as models for this pilot program (Heather Viles and Chris Wood), environmental conservator Steven Weintraub, and if possible a soil scientist. These people can help answer questions concerning the analysis of the results after the data has been downloaded the next field season.
- Test the soil and sand samples collected from the site at the University of Pennsylvania Conservation Laboratory. The tests include salt tests and pH tests for the soil and sand samples.
- Retrieve data loggers and download data anytime after June 28, 2007 (one year exactly after installation).
- Analyze results from data and decide future actions for reburial and capping based on the data.
General
- Plan work schedule for the following season. If the remaining walls for the TB complex will be reburied in the immediate field season, then additional supplies will be needed including sand and soil. It remained unclear how much sieved soil is available at the citadel mound for the entire TB project.
- Test water being used at work site (pH and salt tests).
- Assess the covered original wall plaster in TB4; possibly conduct a condition survey to determine the efficacy of using sandbags to preserve the fabric.
- Determine if exposed upper courses on walls partially reburied should be repointed (TB2 – south wall in anteroom, TB3 south wall).

Mid Term (1 – 5 years)
- Consider installing a monitoring program to test the long-term effects of reburial at the TB Complex (this site can help serve as a model for other archaeological sites in Turkey or sites with similar climate and conditions).
- Leave the data loggers in the pilot area for a longer period to obtain more data for a thorough analysis. It is possible that the plantings/seeds will not grow until after 1 – 3 years (as discussed with Naomi Miller).
- Develop a maintenance program for the Terrace Building Complex, including guidelines for plantings.

Long Term (+5 years)
- Conduct a condition assessment of remaining exposed stones to determine if they can remain exposed or if they need to be reburied.
- Implement and update maintenance program developed for the Terrace Building Complex.
Sources Consulted


Young, R. S. 1957. Gordion Notebook 70. Unpublished field notebook for excavation season

