Conservation Efforts on the Middle Phrygian Gate Complex at Gordion, Turkey

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Abstract. The Early Phrygians constructed the fortress city of Gordion (modern day Turkey), ca. 950–800 BCE. Gordion is renowned as the seat of the most famous Phrygian king, Midas of the Golden Touch, and also where Alexander the Great cut the Gordian knot (333 BCE). Although the ancient site was discovered in the late 1800s, it was not until the 1950s that large-scale excavations were begun by the University of Pennsylvania. Excavations showed that in the 8th century the Phrygians buried the Early Phrygian city with clay fill and rubble packing that formed the base for the new citadel fortifications and the Middle Phrygian Gate Complex guarding the city. Since the Gate Complex was first exposed in the 1950s, faces of the excavated rubble masonry have been subjected to environmental and weathering effects. More recently, sections had spalled off and left several large stone blocks of the Middle Phrygian wall resting above in imminent danger of collapse. In 2016, a site conservation project was undertaken to preserve portions of the Middle Phrygian architecture and stabilize the remains of the rubble masonry in the vicinity of the Gate Complex for safety reasons to protect visitors and the staff. This paper provides information on the conservation and stabilization efforts which have (i) illuminated the Middle Phrygian building strategies, (ii) enhanced the understanding gained during the original excavation in the 1950s, (iii) made the exposed rubble safe again, and (iv) improved the visitor's experience of the overall site and spectacular Early Phrygian Gate Complex.

Keywords: Conservation · Archaeological heritage · Stone masonry wall
Rubble masonry foundation

1 Introduction

The archaeological site of Gordion, in central Turkey near the capital city of Ankara (see Fig. 1), has been the focus of intensive architectural conservation in recent years. The site includes a fortified Citadel Mound measuring ca 450 × 300 m and two walled residential districts. Ridges around the city were used for habitation and at times also as cemeteries, particularly for the tumuli that marked the elaborate burials of the Phrygian elite.

Since large-scale excavations were begun by the University of Pennsylvania in 1950s, architectural conservation efforts at Gordion have largely focused on the wooden tomb chamber in the largest of the tumuli [1], Tumulus MM, built ca.

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Fig. 1. Map of western Anatolia showing the Kingdom of Phrygia with its capital at Gordion [2].

740 BCE, and on the architecture of the Early Phrygian period on the Citadel Mound. The latter efforts have concentrated on the monumental 9th-century Early Phrygian Gate Complex (the best-preserved Iron Age citadel gate in Anatolia) and on the Terrace Buildings to its northwest.

Excavations have exposed Middle Phrygian citadel fortifications and a gate complex dating to the early 8th century, built of large stone blocks embedded within and atop a deep rubble packing that served as foundations [2]. Since the gate complex was first exposed in the 1950s, faces of the excavated rubble masonry have been subjected to environmental and weathering effects. Recently, sections had spalled off and left several large stone blocks of the Middle Phrygian (MP) wall resting above in imminent danger of collapse. Thus, the summer of 2016 saw additional architectural conservation focusing on the Middle Phrygian Gate Complex built above the Early Phrygian (EP) Gate during the 8th century BCE (see Fig. 2).

This site conservation project was undertaken to preserve portions of the Middle Phrygian architecture and stabilize the remains of the rubble masonry in the vicinity of the Gate Complex. The project was essential for safety reasons, to protect visitors and the staff of the Gordion Archaeological Project working on the conservation of the EP Gate; it also enhanced visitors' experience of the site and its spectacular Early Phrygian Gate Complex. The stabilization made new discoveries emerged that yielded a refined understanding of ancient Phrygian engineering approaches to the construction of monumental architecture during the 8th century BCE.

This paper first provides a brief overview of occupation at the site during the Iron Age and explains the archaeology of the Gate Complex and the nature of the platform that supported the Middle Phrygian Gate Building. Then, details are given regarding

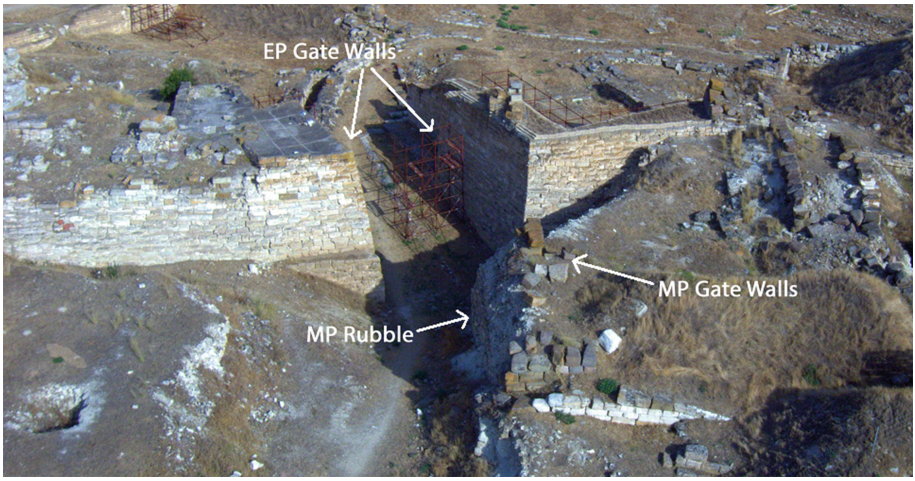

Fig. 2. Early Phrygian (EP) Gate Walls, Middle Phrygian (MP) Rubble and MP Gate Wall remnants atop the rubble

the site conservation undertaken in 2016 to preserve portions of the Middle Phrygian architecture and to stabilize a large section of the rubble fill making up its platform. Consequently, the results enhanced the visitor's experience of the site and its spectacular Phrygian Gate Complex. Site conservation in the summer of 2016 made the rubble masonry safe again and yielded a refined understanding of ancient Phrygian engineering approaches to the construction of monumental architecture during the 8th century BCE. In this way, the recent work paralleled, preserved, and illuminated the actions of the past.

2 Site Description and Background

Gordion was the capital of the Phrygian Kingdom in central Anatolia, a cultural center that flourished in the early Iron Age. The Early Phrygian period (ca. 950–800 BCE) witnessed the development of monumental and ambitiously built architecture, including a massive Gate Building and highly organized industrial complexes. The Middle Phrygian period (ca. 800–540 BCE) saw the apogee of Phrygian influence, power, and architectural creativity, a time when they continued shaping the landscape around Gordion and built new and spectacular fortification walls. The transition from Early to Middle Phrygian is marked by a fire that broke out on the Citadel Mound sometime around 800 BCE. This destroyed the western megarons and terrace buildings that comprised the city's elite and industrial quarters, respectively [3–5]. The new citadel was built on top of and following the same basic plan as the previous one, most of its foundations being laid along with a deep blanket of clay as the area was rebuilt. However, the Phrygian engineers understood that the new monumental gate building would require a support system more solid than clay to hold it, so they created a large rubble stone platform for the massive walls of the new Middle Phrygian Gate Complex

that was built above and to the east of its Early Phrygian counterpart. Like its predecessor, the new gate had a North and South Bastion, each with a court within, and a paved road running through its central double-gated entryway into the citadel (see Fig. 3(a)). These massive stone works were founded upon and within the rubble platform, or fill, that was the focus of the conservation efforts in 2016.

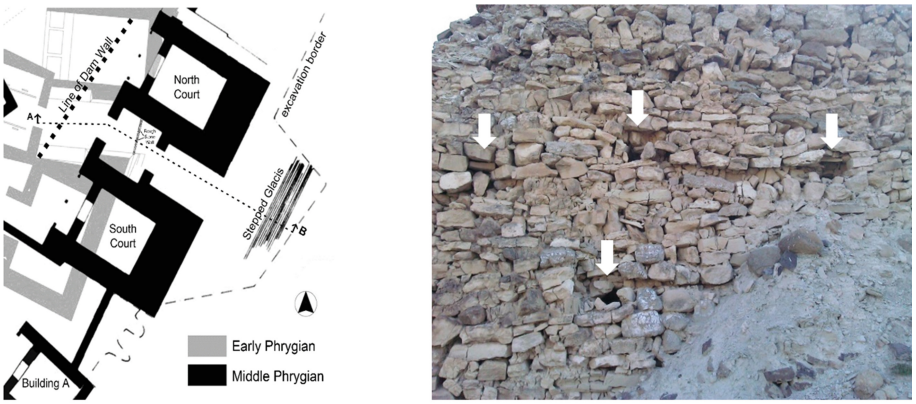

Fig. 3. (a) Plan view of the Gate Building area; (b) Rubble fill close-up view

The Gate Complex area was excavated primarily in 1953 and 1955 by Rodney Young of the University of Pennsylvania. According to him, the nature of the rubble fill was complex, and it included occasional blocks of stone incorporated from the Early Phrygian Gate Complex, but it consisted largely of rough bits of limestone and gypsum from local sources. The mass of rubble and blocks, threaded by occasional juniper logs that served as binders, was retained at the east by a stepped glacis of cut blocks. The rubble masonry was carefully laid in successive vertical strips about 1.20 m in thickness in accordance with a plan calculated to assure stability by counteracting any tendency of the rubble to slide down the slope, and by taking away as much pressure as possible from the inner face of the retaining wall [6, 7].

The rubble fill itself was far from being a random heap of stones; it was rather a carefully built structure with particular logistical approaches used to create the most stable building platform in the shortest amount of time to sustain the great weight of the new Middle Phrygian Gate. The inclusion of juniper logs within the rubble was an important part of the construction technique. These logs were laid both northeast-southwest and also northwest- southeast, at a vertical distance of about 1 or 1.2 m from the logs below and at a roughly similar horizontal distance from each other. The Phrygian builders clearly thought of the logs as providing long-term benefit, since the very dense nature of the juniper added overall stability to the rubble fill as the base for the Middle Phrygian Gate Complex above it. Figure 3(b) shows voids in the rubble fill (arrows) that indicate where the juniper logs were placed. Remnants of rotted wood within the voids are still evident.

3 The Stabilization Project

During excavations in the 1950s, a large quantity of the Middle Phrygian stone packing was removed, leaving a 5 m high semi-stable pile of rubble masonry that still supported several fragmentary walls of the North Court of the Middle Phrygian Gate. The rubble had been eroding steadily for 60 years, gradually becoming far looser and more dangerous. During the winter between 2015 and 2016, many stones fell from the main exposed rubble masonry face which meant that several large stone blocks weighing approximately 600 kg each- at the south interior corner of the North Court of the Middle Phrygian Gate that were resting on this rubble- were in imminent danger of collapse (see Fig. 4). It was crucial to submit the proposals and obtain the permit quickly since the work season lasts only two months at Gordion. Also, material testing and investigation on the rubble masonry necessitated permission from the Historic Preservation Commission and additional funding, both of which were not readily available for this unexpected condition. Mathematical modelling of the rubble masonry failure under such circumstances was extremely difficult, if not impossible. Furthermore, any solution had to be cost-effective and quick to implement in such a remote site.

Fig. 4. Spalls of 2015 winter highlighted with circles and the MP Wall stones resting precariously above

The Gordion team submitted several proposals for the stabilization of the area, including (a) cutting back the slope of the rubble fill along the west portion; (b) installing a gabion wall system along the vertical south face; (c) installing a bracing wall made of a steel frame and wire net along the west portion of the rubble and south face of the fill; (d) encasing the rubble fill and the MP Wall stones with a wire mesh and steel strands to tie them into the ground above and away from the walkway and

(e) a hybrid of features of (a) through (d). Ankara's Historic Preservation Commission approved a hybrid approach that did not require the addition of any modern materials such as steel mesh, cables, or beams, but would stabilize the rubble and minimize the possibility of wall collapse and injury to visitors at the site as described below. It would be inexpensive in comparison to the other options and produce an aesthetically appealing outcome. Before stabilization efforts began, the extant state of the Middle Phrygian wall and rubble was fully documented. The conservation work, which lasted two weeks, consisted of three tasks (see Fig. 5): to stabilize the Middle Phrygian rubble fill by trimming the southwest corner to a 45° angle, presumed to be the angle of repose for the structured rubble fill; to move the existing Middle Phrygian wall stones to their new location in the northeast corner using a mobile crane; and to trim the south face to a 45° angle by creating multiple rubble steps, or benching (see Fig. 6).

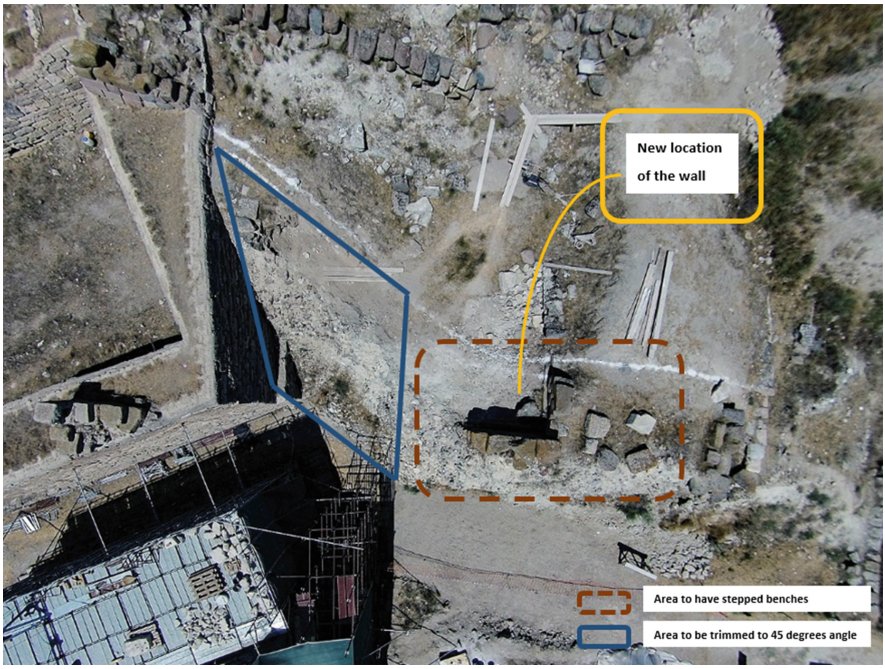

Fig. 5. Aerial photo summarizing the stabilization works mentioned

Moving the corner wall from the south to the north side required the preparation of a new foundation prior to its reconstruction. Before the stones were moved, all of them were marked and numbered, enabling the reconstruction of the wall as close to its original configuration as possible. The blocks were then reassembled in their original positions, but rearranged to create an outside corner of the massive building rather than the original corner of the interior room. The east-west wall was reconstructed running east-west as before, while the alignment of the north-south wall was changed 180° to

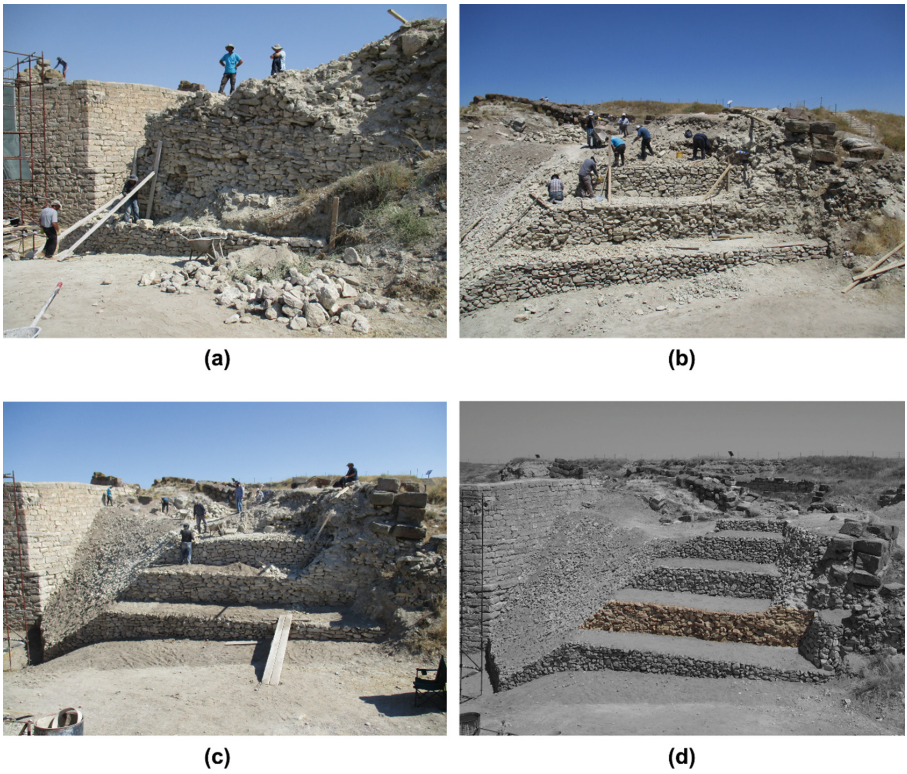

Fig. 6. (a) Benching starts from the bottom; (b) after the third step is finished; (c) providing steps with earthen caps; (d) after completion of works — original rubble face is highlighted.

face the visitor circuit, so that its original exterior face remained exterior. The east-west wall was preserved to a maximum height of 2.03 m and a maximum length of 3.43 m; the north-west wall was preserved to a maximum height of 1.51 m and length of 2.37 m (see Fig. 7). The total number of stone blocks removed from this wall corner was 36; eight of them were foundation stones originally set within the rubble during the Middle Phrygian period and therefore not visible in antiquity. An interesting feature of wall construction that became clear only during its dismantling was the extensive use of mud mortar between both the stones and the courses. Such mud mortar is lacking in Early Phrygian wall construction and apparently a new feature of Middle Phrygian engineering. To reduplicate the original construction technique, mud mortar was used during the reconstruction, which made it easier to move the blocks into their place; it also prevented any stress concentration that would cause cracking of the stones.

The rubble slope on the southwest side of the project area was built by removing stones from the precipitous and unstable parts of the slope above and constructing a smooth even slope at the desired angle, from the bottom up. During this work a few fragments of juniper logs were found in the rubble fill. The log fragments were recorded and removed for conservation and study.

Fig. 7. Reconstructed wall

The south face of the rubble masonry was trimmed back to benched steps to create a 45° angle after the removal of the Middle Phrygian corner walls, and in the process of benching additional juniper logs were discovered in the rubble. The process of building vertical faces along the sides of the benched steps replicated the ancient construction technique of the Middle Phrygian architects. The first step of the slope was built on ground level to support the existing rubble wall face. The steps were mostly a little over a meter high: from the bottom, they were 1.05, 1.20, 1.20, 1.15, and 0.55 m tall, with a tread of 1.30, 1.40, 1.45, and 1.45 m. The second step was made by patching the voids of the existing interior rubble wall face with supplementary stones to make it complete again now as it had been in antiquity. Thus the original ancient strip wall face that the Phrygian architects once created within the rubble forms the face of the second step in the modern conservation. The remaining steps were constructed by hand with the stones from the rubble fill, during which we adopted a technique similar to that used in the construction of the original rubble fill during the 8th century BCE. The result was an off-set stack of four full steps and a partial step at the top (see Fig. 6). To prevent accumulation of water and water-caused erosion necessary measures were taken. In the future, a natural erosion-proof soft cap for the steps at the south face of the Middle Phrygian rubble masonry will be implemented using local shallow-root plants, such as the Poa bulbosa meadow grass [8].

4 Conclusions

This study presents information on the historical and archaeological background of the Middle Phrygian Gate Complex at Gordion, Turkey and briefly explains the observations and results of the conservation work conducted in 2016 summer. The site conservation undertaken on the Middle Phrygian Gate Complex at Gordion in 2016 began as an essential project for safety reasons, and it ultimately created significant

additional understanding of the Middle Phrygian engineering that created the monumental gateway, and it improved tourists' experience of the site. Several important new recognitions and discoveries concerning the complex rubble masonry structure underlying the Middle Phrygian Gate walls emerged from the stabilization work. It became clear that the rubble was carefully constructed with internal wall faces. These provided internal cohesion and structure to what would otherwise have been a formless mass. Juniper logs were laid at crucial points to provide a stable and flexible support as well as offering a tie-in to help spread weight and hold the rubble itself together. It may be significant that many of the logs discovered in 2016 were set under the corner of the Middle Phrygian Gate's North Bastion. Such wood would have been useful in distributing the weight above it evenly, thereby preventing differential settlement of the rubble masonry as well as cracking and spalling of the somewhat brittle stones that comprised the horizontal surfaces. Moreover, timber ties substantially enhance the deformation capacity of masonry structures under compression, as well as help reducing vertical cracks [9].

In conclusion, what could have been a disastrous collapse was prevented and converted into a project that produced new archaeological data and a useful synthesis of recent work on the gate, as well as making the site more understandable and aesthetically appealing to visitors.

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