APPENDIX A:

CHRONOLOGICAL LIST OF MAJOR PERIODS, RULERS AND DYNASTIES

All dates are approximate, from Seidlmayer 2006 and O'Connor 2009: 208

Predynastic (5,500-3,100 BC)
Badarian period 5,500-4,000 BC
Naqada I (Amratian) period 4,000-3,850 BC
Naqada II (Gerzean) period 3,850-3,300 BC

DYNASTY 0 Naqada III a-b period (3,300-3,100 BC)
(about 15 rulers)
Owner tomb UJ at Abydos
'Irihor'
Sekhen/Ka
Scorpion
Narmer

Early Dynastic (3,100 – 2,800 BC)
1st DYNASTY
Aha (Menes?)
Djer
Djet
Queen Merneith
Den
Anedjib
Semerkhet
Qaa
(Sneferka: absent from later king-lists)

2nd DYNASTY (2,800-2,650 BC)
Hotepsekhemwy
Raneb
Ninetjer
Weneg
Sened
Peribsen

Khasekhemwy

Old Kingdom (2,650-2,175 BC)

3rd DYNASTY (2,650-2,580 BC)

Djoser (Netjerikhet)

Sekhemkhet

Khaba

Zanakht

Huni (Qahedjet)

4th DYNASTY (2,580-2,450 BC)

Snefru

Khufu (Cheops)

Djedefre (Redjedef)

Khafre (Chephren)

Nebka (Baka, Neferka, Neferekare, Nebkare, Maka, Horka and Aaka)

Menkaure (Mykerinos)

Shepseskaf

5th DYNASTY (2,450-2,325 BC)

Userkaf

Sahure

Neferirkare

Shepseskara

Raneferef

Niuserre

Menkauhor

Djedkara

Unas

6th DYNASTY (2,325-2,175 BC)

Teti

Userkare

Pepi I

Merenre

Pepi II

Merenre II

Nitokris ?

APPENDIX B:

PROTOCOL FOR MUDBRICK ANALYSIS

The following appendix outlines the protocol used in the field to analyse mudbrick for the purposes of this research, which is followed by details of the sampling strategy carried out in 2009 and 2010 and an example of the Sample Description sheet used.

1. Textural Description of Mudbrick

This stage consists of recording for each mudbrick the following,

- Colour of the wet mudbrick using a Munsell colour chart
- Paste homogeneity
- Paste texture
- (Type and orientation of inclusions)

2. Field Grain Size Analysis of Mudbrick

Apparatus

- Munsell colour chart
- 0.01g scale with calibration weights
- 12 large glasses for samples tall enough to mark 8 cm, glass (plastic creates static)
- 50 g p/L of water of sodium hexametaphosphate or Calgon
- 63 large micron sieve, metallic
- Brita water filter
- Brita water filters
- Squeeze bottle
- Brush with natural hairs (plastic creates static)
- Plastic resealable bags
- Permanent marker
- Ruler
- Stirrer
- Watch/clock
- Optional bucket to collect water if no sink

Protocol Stage 1 – Sample Preparation

1. Sodium Hexametaphosphate or Calgon solution ready 1 day before use
2. Mark glasses with 8 cm mark
3. Crush mud brick sample

4. Quarter sample if necessary
5. Note sample number + FINAL DRY WEIGHT
6. If samples are likely to be clayey, soak for 1 day in normal water and do regular hourly pours
7. Prepare samples and stir at desired time, leaving 2 min between each and at least 15min in between last and first in order to refill water bottles, water filter and squeeze bottle Carry out a visual textural description and take pictures of samples.

Protocol Stage 2 – Defloculation

1. Pour soil sample into glass and add sodium hexametaphosphate solution (hereafter s.h.): 50 cl for 60 g, or 25 cl for 40 or 30 g.
2. Complete with filtered water up to 8 cm mark
3. Stir vividly without spilling
4. Let solution settle for 1 hour or the time necessary for silts to settle
5. Make note of settling start time (basically just after stirring).

This defloculates clays and silts from coarser grains. Silts and sands fall while clays remain in suspension.

CAUTION: do not leave sample with s.h. overnight, as it will reverse the effects of the defloculation.

Protocol Stage 3 – Clays

1. After 1 hour, or the time for silt and sand to settle, start hourly pour to remove the clays. Pour with a steady hand, making sure no coarse grains (anything that can be seen) are lost while pouring. If uncertain, stop pouring and wait for sediment to settle to continue pouring.
2. Refill glass with purified water to just under the 8 cm mark and stir. Repeat hourly until water becomes clear (milky). If need to leave sample over night, restir in the morning and continue hourly pour.
3. Final pour: make sure all the water is poured out to enable the sediment to driy faster. It is OK to lose a few grains in the process. Ensure the sample is not left to dry in windblown area as aeolian deposits could affect final results.
4. Tare beaker used to weigh silts and sands and weigh dry sediment.

5. Subtract this weight to the initial total dry weight in order to obtain the amount of clay. Make a weight percentage (divide amount by total weight and multiply by 100)

Protocol Stage 4 –Silts and Sands

1. Either empty dry silts and sands into sieve and wet in the sieve, or mix the sand and silt in a beaker with purified water and then pour into 63 micron sieve using a squirt bottle. The latter is better as there is less risk of losing grains.
2. Wet-sieve until the water runs clear. If sieve gets clogged, rub gently from below with fingers; never apply pressure from the top as this forces the grains through the sieve.
3. Collect the sand in the sieve and pour into beaker using a skirt bottle from underneath.
4. Dry and weigh sand. Subtract sand and clay from the total dry weight. This gives the weight of the silt. Make percentages for all.

3. Sand Sorting and Microartefact Analysis

There are different categorisations for sand sorting; the one used here is adapted, as follows, for the purpose of this mudbrick analysis from Bullock et al. (1985: 26).

- Very well sorted: 2 finest grade dominant with finest grade > 60 % and rest < 10 %
- Well sorted: 2 finest grades dominant with finest grade < 60 % and rest < 10 %
- Moderately sorted: as above, with rest between 10-30%
- Poorly sorted: 2 finest grades dominant with finest grade < 60 % and rest > 30 %

Apparatus for Sand Sorting and Microartefact Analysis

- Nested sieves, metallic
- Binary microscope
- Petrie dish/container
- Ruler
- Paper

Protocol for Sand Sorting and Microartefact Analysis

Use this method to determine the type, size and distribution of sand and pebble sized microartefacts. Use nested sieves to determine the distribution of grain sizes. Use

magnifier to identify objects over 2 mm and a binocular microscope to identify objects under 2 mm. The distribution of the sand size grains informs on the source and modes of transport of materials. The mineralogy informs on the potential sources of sediments and where in a settlement or activity area the mudbrick manufacturers may be getting their material i.e. slags come from a manufacturing/production area versus domestic context.

1. Wet sieve sediments out during the G.S. stage outlined above
2. Dry the sands
3. Use metallic nested sieves to sieve the dry sand by shaking hard and for the same amount of time for each sample to separate the sands into seven different size factions ranging from 4 mm to 0.063 mm
4. Use a stereo-binocular microscope to identify a) the presence or absence of different categories of artefact types, such as unmodified rock, modified rock, ceramic, concretion, bone/shell, metal etc and b) the roundness, sphericity and polish or patina of quartz (Rosen 1986: 77).
5. Can also calculate ratios of each category by taking 5 g split spread equally onto petri dish under which a graph paper with 1 cm grid intervals is split. Can also increase grain count of many different material categories (20 v 5); 100 grain grid x 10 => count 1,000 total. Then convert proportions into weight percentages.
6. Proportions can be calculated two ways, either a percentage for each material type/category across grain size, or percentage of each material type in one phi size.
7. Recording the data: Presence/absence of material types in each phi size category, rather than percentages, as I could not be precise enough and take systematically the same volume of material.

CAUTION: Problem with identification of ceramics and concretions under 0.50 mm (1phi) as they look the same.

SAMPLE DESCRIPTION

Sample number	
Unit	
Brick Dimension	
Munsell Colour Wet	
Picture number	
Visual Textural Description	

Defloculation and Clay	**Results**	**Remarks**
Sample Dry Weight(g.)		
Volume of S.H. (cl.)		
Defloculation Start Time		
Pouring 1 Start Time		
Pouring 2		
Pouring 3		
Pouring 4		
Pouring 5		
Pouring 6		
Pouring 7		
Pouring 8		
Pouring 9		
Pouring 10		
Pouring 11		
Pouring 12		
Pouring 13		
Pouring 14		

Silts and Sands	**Results**	**Remarks**
Silt & Sand Dry Weight (g.)		
Sand Drying Start Time		
Sand Weight (g)		

Final Results	**Weight (g.)**	**Weight Percentage**
Sample Total Dry Weight		100 %
Clay (total weight – silt & sand)		%
Silt (total weight – clay – sand)		%

Sand		%

Sampling

Sampling Limitations

I only sampled accessible bricks that are not structurally significant, limiting the number of samples that may be obtained. For instance, only two bricks were sampled for the southwest wall of the Fort at Hierakonpolis. The Fort has been significantly restored, which limited access to material. Also bricks from the Fort's second construction phase's upper courses were generally not sampled. There were exceptions however where the wall collapsed, which occasionally made the bricks accessible on the ground. However, the use of fallen bricks to complement information can only be done when the construction phase they belong to can be determined with certainty. It is also important to try to use samples obtained from the interior of the brick as mud-runs after rainfalls, or aeolian sand deposition, are likely to affect the composition results.

APPENDIX C:

ADDITIONAL COMPOSITIONAL ANALYSIS OF MUDBRICKS FROM HIERAKONPOLIS

The analytical work carried out on five bricks from four additional structures at Hierakonpolis is presented in this appendix to provide further insights into the compositional aspects of mudbrick production at the site. The structures include a ceremonial building, two tombs from the elite cemetery HK6 (tombs 10 and 30) and a mastaba tomb (see map. 1; Quibell and Green 1902: 63-64; Friedman 2008, 2009, pers. com.). Since this sample was limited to one brick per structure due to time constraints, the terminology of 'recipes' adopted here should be treated with caution but is sufficient to make a preliminary proposition that that some fairly distinct approaches to making mudbrick were used for different structures across the site.

1 .Ceremonial Structure HK29A

A Predynastic ceremonial structure at Hierakonpolis, known as HK29A and hereafter referred to as the Temple, was built at the edge of cultivation south of the wadi, in the densest part of the Predynastic settlement. At the time, the settlement formed a single unit with the ancient site Nekhen. The ceremonial structure in question appears to have been in use from the Predynastic to the end of the 1st dynasty and been rebuilt on several occasions (see map 1; Friedman 2009). Only the foundations of the structure's last phase remain. Because the bricks that were visible appeared homogenous in both colour and texture, a single sample taken from the easternmost north-south running wall of the last phase should be a good indicator for the recipe employed for the Temple's last phase.

1.a. Brick Description

The brick sampled was dark brown (10 YR 3/4 of the Munsell colour chart) and had a silty loam texture (figs. 1 and 2) that contained occasional clumps of a black sediment (10 YR 2/1 of the Munsell colour chart). From what could be determined visually, the brick contained very little chaff or traces of, as well as that of any other organics, such as straw or manure. Large pieces of charcoal (c.±1 cm) and smaller pieces of burnt sediment (> 1 cm) were present in small quantities. The sand-sized grains are well sorted and formed of a predominance of finer grade sands (fig. 9a). The coarser sand-size grades consisted of (a) water-worn sub-rounded to rounded pottery fragments from early tell occupation, (b) concretions that are typical of reducing muds and canal dredges, and (c) traces of land snail shell, which is characteristic of shallow marshy environments (Morgenstein and Redmount 1998: 137). Traces of quartz sand with desert varnish was present across all grades, but in much lesser quantities than in other

bricks tested from Hierakonpolis.

1.b. Compositional Commentary

The compositional analysis suggests that two types of sediment were likely employed for the manufacture of the Temple bricks. A fresh silty alluvium formed of reducing muds and oxidised terrigenous (dry land) muds and silty muds. The colour of the brick, grains size distribution and sand sorting and composition suggest this was the reducing muds, which are typical of very low energy alluvial conditions, such as an oxbow lake, lagoon, marsh, canal and/or harbour, were the main sediment used (i.e. reducing clays and silty clays) and the clumps of black sediment indicate that reducing muds were either dried or partially dried at the time of use (Morgenstein and Redmount 1998: 140). Although this cannot be absolutely proven, drill cores carried out near HK29A helped determine the presence of an ancient canal in the immediate vicinity of the Temple that was in use from the Predynastic to the ED when it dried up (Bunbury and Graham 2008). Whether this canal was still in use when the final phase of the Temple was erected is unknown. Regardless, spoils from this canal may be considered a likely source for the alluvium considering its proximity to the site and the fact that that clumps of dried sediment ware still visible. This source would have been especially useful if the mud bricks were produced on or near the construction site.

The other sediment used in lesser quantities consists of oxidised terrigenous muds and silty muds dominated by iron oxyhydroxide that are commonly deposited by flood episodes. The iron gives the sediment its yellow-brown hues, which is so common in the bricks from Hierakonpolis (7.5 to 10 YR of the Munsell colour chart; Morgenstein and Redmount 1998: 139). Palaeo-silts known as the Sahaba or Masmas silts would have been an ideal source and may have been used because of their relative proximity to the Temple but also because their relatively low clay content (fig. 3) would have helped to reduce the naturally high clay content that tends to characterise reducing muds.

Few fresh organics were added is likely due to the fact that those naturally present in the reducing muds sufficed. This in fact is one of the advantages of using reducing muds in brick making. The ash/charcoal, likely added to strengthen the brick, was sourced from a “clean” source, i.e. not from an activity/cooking area (Emery and Morgenstein 2007).

As such, the Temple brick shares certain similarities with Morgenstein and Redmount's Type C brick of their mud brick typology. It describes a brick paste composed of oxidised terrigenous muds and silty muds in which clumps of dried reducing muds are present (Morgenstein and Redmount 1998: 140). Hence, it is not a well-mixed paste and Type C bricks may have had problems connected with the two sediments' internal boundaries. Nevertheless, these bricks are characterised by a high bearing load and good fracture characteristics; in other words, they make excellent quality bricks (*op. cit.*).

2. HK6 Tomb 10

Tomb 10 is part of the elite cemetery known as HK6, which is one of two cemeteries located in the Wadi Sufian, 2 km west of cultivation (the other is HK11e, a workmen's cemetery associated with the wadi settlement HK11; see map 1; fig.7). HK6 was in use from the Late Predynastic, Naqada Ic, to the end of the 2nd dynasty and maybe early 3rd dynasty (Friedman 2008). While all the wadi cemeteries were abandoned in Naqada IIc, as part of a notable change in wadi settlement and cemetery locations in favour of emplacements closer to the floodplain, HK6 is the only cemetery that was returned to, most probably owing to its importance as the main local elite cemetery (*op. cit*.). Tomb 10 dates to the period following this return, Naqada IIIa2-b (Adams 1996, 2000). Of the tomb superstructures, nothing remains. Two samples for Tomb 10 were obtained from the bricks lining the tomb substructure, one for each of the distinct colour groups of mud bricks noted. Although the use of such a small sample for understanding brick recipe urges caution, the evidence the analysis provides does allow us to make a preliminary distinction between two different recipes used for Tomb 10 bricks. The compositional analysis confirmed two distinct recipes both of good quality, referred to as Recipe A and Recipe B. The recipes share certain commonalities but also present certain interesting differences, the details and implications of which are offered below.

2.a. Brick Description, Recipe A (sample HK.BL.2)

The brick sample for recipe A (HK.BL.2), which was obtained from the west wall of Tomb 10's substructure and belonged to the very dark grayish brown group, had a clayey loam texture (figs. 1, 2). The brick had occasional clumps of dark yellowish brown sediment and traces of specks of a reddish sediment (10 YR 4/2 and 2.5 YR 4/8 of the Munsell colour chart). From what could be determined visually, the brick contained an unusually high quantity of fresh organics. Ash/charcoal was also used in

similar quantities, likely giving the brick it's very dark grayish colour. Pottery fragments were used as coarse temper. The sand-size grains are poorly sorted (fig. 9b) and consist of (a) well-rounded pottery, (b) quartz, polished mostly, though some showing desert varnish were also resent in lesser quantities, and (c) traces of unidentified rock, (d) burnt sediment and (e) charred blue bones (the latter indicating burning at very high temperatures).

2.b. Compositional Commentary

Recipe A brick stands out from other recipes at Hierakonpolis in its high clay content, and the analysis suggests that two sediments were likely mixed together to get the right consistency. The high clay content and well-rounded polished quartz and pottery present in the sands, points to the likely use of reducing muds by a Tell, and the textural clumps visible indicate that a dark yellowish brown sediment, possibly dried oxidised terrigenous muds dominated by iron oxyhydroxide was also used. The locally available palaeo-silts (Masmas) fit such a description and are a likely source. Poor sand sorting is uncommon at Hierakonpolis and generally avoided in brick making as it undermines the strength of a brick. Yet, in this case is may indicate a strategy to minimise the shrink/swell of a high clay content paste.

The lack of concretions is interesting, as concretions tend to be present in the local silts. This could suggest that either (a) they targeted another unknown source of sediment elsewhere in the landscape, or (b) that they used the local silts after sieving or levigated them to remove the concretions–something also commonly done to separate clays–and which may be expected if the sediment was used for other reasons, such as rough ware pottery making. The high firing temperature of the charcoal is something that may be expected when using charcoal from an activity area rather than domestic hearth. Hence, although this remains speculative, the high clay content, quantity of charcoal and its high firing temperature, and the proximity of the tomb to the wadi activity area/settlement HK11 where much of the ingredients used for the mud brick production would have been present for the manufacture of pottery–including rough ware–and brewing, may suggest that the bricks were produced in the wadi at HK11 rather than the cultivation. These points will be returned to later in the discussion.

Recipe A brick stands out from other recipes at Hierakonpolis in its high clay content, which altogether with the pottery fragments, high fresh organic and charcoal content,

might reflect a strategy designed to make strong, lasting bricks. The large volume of fresh organics is a useful means to temper a paste with a high clay content.

2.c. Brick Description, Recipe B (sample HK.BL.3)

The second sample, which was taken from the east wall of the substructure of Tomb 10 and belongs to the dark brown (10 YR 3/5 of the Munsell colour chart) group of bricks, had a sandy loam/ clay loam texture. Unlike Recipe A, it has no textural clumps and from what could be determined visually, the brick contained much less chaff and charcoal then the previous brick (figs. 1, 2, 9b). Also, unlike Recipe A, its sands are well sorted with a fine grade dominance, consisting mostly of (a) quartz sand, half of which is polished, half of which shows desert varnish and (b) pottery, (c) stone and (d) flint and (e) a few concretions in lesser quantities for the coarser grades.

2.d. Compositional Commentary

Like Recipe A, the Recipe B brick has a higher than average clay content than that which is normally seen at Hierakonpolis. However it is sandier, but has well sorted sands, and had much less organic and ash temper added to the mix. The texture and the colouration of the brick, combined with the quartz and concretions content of the sand size grains could point to the use of similar oxidised terrigenous muds dominated by iron oxyhydroxide. Given the desert varnish on the quartz grains, local palaeo-silts would be a likely source, as with the previous recipe. Though this remains tentative, since the tombs are cut in such palaeo-silts (Friedman July 2013 pers. com.), perhaps they conveniently re-used what was excavated (see map 1; see Harlan 1982; Takamiya 2008; Baba 2009; Fahmy *et al.* 2011). The sands also suggest that fresh alluvium was also used. The brick's sandiness and constituent pottery, stone and flint are probably the result of tempering with midden waste, possibly from a stone-working area, suggesting a different strategy to that seen with the Recipe A brick discussed above. However, while the pottery certainly came from midden waste, as the ash, the stone fragments could have been introduced through the sediments themselves, as sandstone and limestone are conspicuous at Hierakonpolis. The manufacturer of Recipe B preferred a sandier texture, but one that consisted of well-sorted fine sands with some midden waste, and adequate mixing of the paste, both of which are important for the manufacture of quality bricks. This shows a different strategy to the previous batch of bricks.

3. HK6 Tomb 30

Tomb 30 is also part of the elite cemetery HK6 and has been dated to the 2nd or 3rd dynasty. The brick sample (HK.BL.1) was obtained from a stack of bricks that had been removed from the substructure and laid beside the tomb (fig.8). The bricks appeared very homogeneous hence the following description should be a good indicator of the recipe employed for Tomb 30. Overall, the brick shares similarities with Tomb 10's Recipe B and the Fort bricks.

3.a Brick Description

The brick sampled was brown to dark yellowish brown (10 YR 4/3-4/4 of the Munsell colour chart) and had a loam texture (figs. 1, 2, 9b). From what could be determined visually, the paste called for very little organic temper. Large pieces of charcoal were present and the microscopy revealed burnt sediment and charred organics, which may come from the use of clean hearth waste and/or field-burning (Emery and Morgenstein 2007). The sand-size grains are well sorted with a fine grade dominance. The coarser grades include (a) pottery, (b) charred remains and (c) concretions predominantly, with (d) bone and (e) stone fragments in lesser proportions. Quartz sand with desert varnish mostly, though some are polished, is present throughout the grades and dominates the finest grades.

3.b. Compositional Commentary

The colouration and composition of the brick, which is similar to Tomb 10's Recipe B brick, points to the same use of oxidised terrigenous muds. Given the predominance of desert varnish quartz, nearby palaeo-silts is a likely source. The polished grains point to the addition of fresh alluvium from the cultivation, possibly in lesser quantities. The manufacturer appears to have relied more on ash and midden waste to strengthen the brick rather than organics as temper, as well as good mixing and sand sorting. In this sense it is very similar to tomb 10 group B bricks despite not being contemporaneous, but a bit later in date.

The brick's slightly higher than average clay content, something which it shares with the other bricks sampled from Tomb 10, may suggest that it is a feature of HK6 bricks and something worth investigating further with future research. Given the similarity of the recipe with Tomb 10's Recipe B bricks, the possibility of a production in the wadi should be considered and potentially explored further. The analysis revealed that the

recipe also shares a number of similarities with the Fort bricks, notably a similar dimension, a brown to dark yellowish brown colour (10 YR 4/3-4/4 of the Munsell colour chart) and a loam texture (figs. 1, 2, 9b). This could make sense, as they are more or less contemporaneous.

4. Mastaba

A brick sample was taken from the superstructure of the largest and westernmost of three mastabas built at the edge of the cultivation valley north of the Fort (see map 1; Quibell and Green 1902: 63-4). Very little is known of these mastabas, which have been tentatively dated to the late 2nd early 3rd dynasty (*op. cit.*). Almost nothing remains of their superstructures; the one the sample was obtained from was the least damaged despite its poor state of preservation. Yet, the bricks appeared highly homogeneous, suggesting that the brick in question is likely to be a good indication of the overall recipe used for the mastaba.

4.a. Brick Description

The brick is dark brown (10 YR 3/3 of the Munsell colour chart) and has a sandy loam texture (figs. 1, 2). From what could be determined visually, the paste contained larger amounts of chaff than what is commonly seen at Hierakonpolis and appeared to also contain manure. Ash/charcoal seemed absent from the mix and could only be determined in small quantities through sand microscopy. The sand-size grains are poorly sorted (fig. 9a) and consist of (a) stone fragments, mostly sandstone with some flint, (b) quartz sand with desert varnish and (c) concretions. It was not possible to determine whether the stone fragments were introduced via the main sediment used or if they point to the use of midden waste from a stone-working area.

4.b. Compositional Commentary

This brick clearly stands out as the sandiest of all bricks and the one poorest in quality tested at Hierakonpolis. While the mastaba brick recipe probably employed a similar terrigenous silty sediment to the one used in some of the other recipes, such as the palaeo-silts widely available at Hierakonpolis, it did not appear to use fresh alluvium. While using both sediments is not essential if one knows the materials they are working with, it is a disadvantage to one who does not. In addition, the mastaba brick has one of the lowest clay contents, is far sandier with poor sand sorting and only employed a very limited amount of ash/charcoal, which is surprising given its widespread use in other

recipes at Hierakonpolis (fig. 1). The organic temper added in large quantities to the mix seems to have made no difference to the brick's quality, possibly highlighting the importance of sand sorting for mud brick manufacture, as well as slightly higher clay content and ash. While the tomb's proximity to the cultivation probably made it an ideal target for brick re-use, whether as construction material or field fertiliser, the brick's poor quality certainly contributed to the degree of deterioration of the mastaba. Altogether, the mastaba brick clearly stand out from the other bricks tested at Hierakonpolis in sandiness and poor quality.

5. DISCUSSION

Several points of interest are offered in the following discussed. These are (a) the mixing of two distinct sediments in varying proportion highlighting the importance of the use of both fresh alluvium and palaeo-silts at Hierakonpolis (b) the high clay content of the HK6 bricks and (c) a possibility for a separate wadi production for the elite tombs at HK11.

It is noteworthy that all recipes, bar the later mastaba brick, seem to point to the use of different sediments. The Temple brick appeared to use fresh alluvium in greater quantities than any other bricks tested so far at Hierakonpolis. The more extensive use of fresh silty alluvium in combination with palaeo-silts for the Temple brick seems to be a direct correlate of its good quality. Altogether the production of these bricks very cost-effective, as all materials were most likely immediately accessible by the construction site, in the settlement and cultivation area. If local canal dredges and palaeo-silts were used for bricks produced on site, then the Temple mud brick stands out from the others at Hierakonpolis in its high fresh silt content, its overall quality and the cost-effectiveness of its production. The recipes of the two HK6 elite tombs, T10 and T30, are also interesting in this respect, as all also seem to combine sediments.

In addition, all HK6 bricks tested seem to be characterised by higher clay content than other Hierakonpolis bricks. High clay content is advantageous for mud brick, as it makes stronger brick and helps build longer-lasting structures, but it also means an increase in labour, as mixing clay-rich sediment is painstaking (Rosen 1986: 76). As such, it is often considered to be tied to a more valuable production. This could very well be the case for the HK6 bricks destined for the local elite's tombs. While it is possible that the bricks were manufactured in the cultivation valley and carried about 2

km up the wadi to HK6, representing a considerable amount of work, the profile of these bricks and proximity of HK6 to the wadi settlement and activity area HK11 where pottery was made and beer brewed, may make more sense of the patterns noted for the HK6 bricks, and point to a separate, wadi production. The manufacture of pottery and the brewery meant that most of the materials - water, clay-rich sediments, organics, midden and hearth waste - used for the mud brick were already present at Hierakonpolis. It also meant that a useful 'sister expertise' of mud brick manufacture, pottery production, that knows how to deal with high clay contents, was also present on-site. Indeed, pottery production and mud brick manufacture share many similarities in terms of the knowledge required, especially that of materials and their properties. A wadi production, and more specifically one attached to HK11 that already served the elite cemetery at HK6 could explain the higher clay content visible in all HK6 bricks and the ingredients and overall strategies visible in the bricks. In terms of labour, this might also suggest a redirecting of resources, both natural and human possibly from pottery to mudbrick. Therefore, while greater use of clay may be associated with more prestigious brick manufacture because more costly. In this case, it may also point to a manufacture in the wadi, possibly at, or near, HK11. Just like brewing and pottery making was kept separate from those in the valley, the same may have applied to the mud brick production for the elite tombs at HK6 (Friedman July 2013 pers. com.).

The fact that fresh alluvial silt was used but in much lesser quantities than the Temple bricks for instance, might be a factor of distance. If the fresh alluvium was brought especially, it would have added to the cost of production. Yet, for some reason, it was important to include fresh alluvial silt in these bricks. The similarities shared between the earlier bricks of Tomb 10 and the later ones of Tomb 30 suggest an interesting continuity in practice that may lend further weight to the importance of a local, separate mud brick production for HK6 bricks. It is even more interesting when once considers that the mastaba brick, which was much closer to the cultivation, did not seem to make use of fresh alluvium. While it might be pushing the evidence to suggest that the mastaba recipe, which is very poor in quality and reflects a more careless manufacture compared to other bricks at Hierakonpolis, supports a specialist production in the wadi for HK6 mud brick because of its later date, it does highlight a difference in practice that may be associated with structure types and cemetery location.

Before concluding, a final note should be said about the mastaba bricks. While the

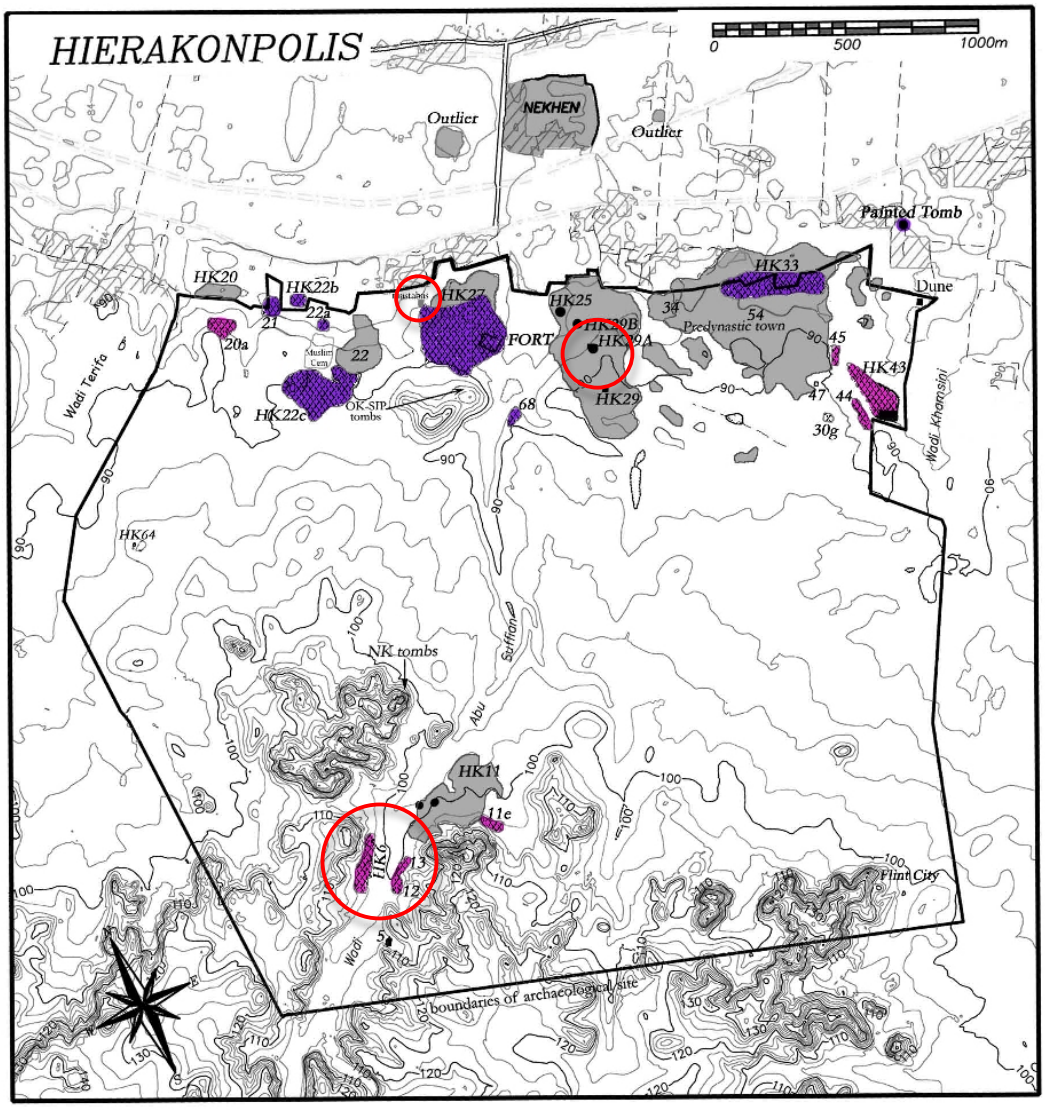
sandiness of the mastaba brick stands out from all other bricks at Hierakonpolis, it compares in interesting ways with a modern sandy brick made as an experiment for the Fort's conservation, using Sahaba Silts alone. The two bricks have the same colour, dark brown (10 YR 3/3 of the Munsell colour chart) and have a similar proportion of clay (figs. 1, 5, 6). However, the modern brick is less sandy (figs. 2, 6), has no ash or organic temper, and has very poorly sorted sands formed uniquely of quartz with desert varnish (fig. 9e). The brick crumbled within days of manufacture, indicating the recipe's very poor quality (Friedman February 2009 pers. com.). Hence, if one is to make a good brick, the Sahaba silts cannot be used alone, not in the way it was for the modern brick in question. As such the ancient mastaba brick can be very informative in terms of what helped make it slightly stronger than its modern counterpart. Despite the mastaba brick being sandier than the modern sandy brick, the fact that the sands were in large part midden waste and not pure sand quartz, that some, though little, ash was used, as well as larger quantities of fresh organics and slightly better sand sorting, may altogether explain why the mastaba bricks are stronger than their modern sandy counterpart (fig. 9a). Although it is unclear why a relatively poor mud brick recipe was adopted for the mastaba, it is possible that a sandy recipe was preferred, as it provided a cheaper way to make a larger volume of bricks a mastaba superstructure required. As mentioned earlier, limiting the amount of clay further limits the amount of labour.

Altogether, the strategies at Hierakonpolis reflect a preference for locally available sediments, including the wide spread use of the palaeo-silts, but also the use of the fresh alluvium whenever possible. Such a preference is clearly visible for the Temple bricks but also in the effort to bring it up to HK6/11 c.2km up the wadi from the cultivation.

6. CONCLUDING REMARKS

In conclusion, although just a preliminary study, the results strongly suggest that a variety of recipes were used at Hierakonpolis, with different approaches to the manufacture of mud brick across the site. These have interesting implications for understanding the decision-making process and possibly the value this material (and/or its constituents) had for the ancient inhabitants at Hierakonpolis. Recipes, which are generally good, still range from poor (mastaba), in rare instance, to excellent (Temple), reflecting a certain hierarchy of recipes. The preliminary results also suggest that a separate mud brick production may have been observed for the elite cemetery at HK6, just like the brewing and pottery production that were kept separate for the elite. Further

research would help confirm, or negate, some of these trends and also help determine whether these different approaches to mud brick production are site, structure and/or period dependent.



Map. 1. Map of Predynastic and Early Dynastic Hierakonpolis showing localities where structures were sampled (http://www.hierakonpolis-online.org)

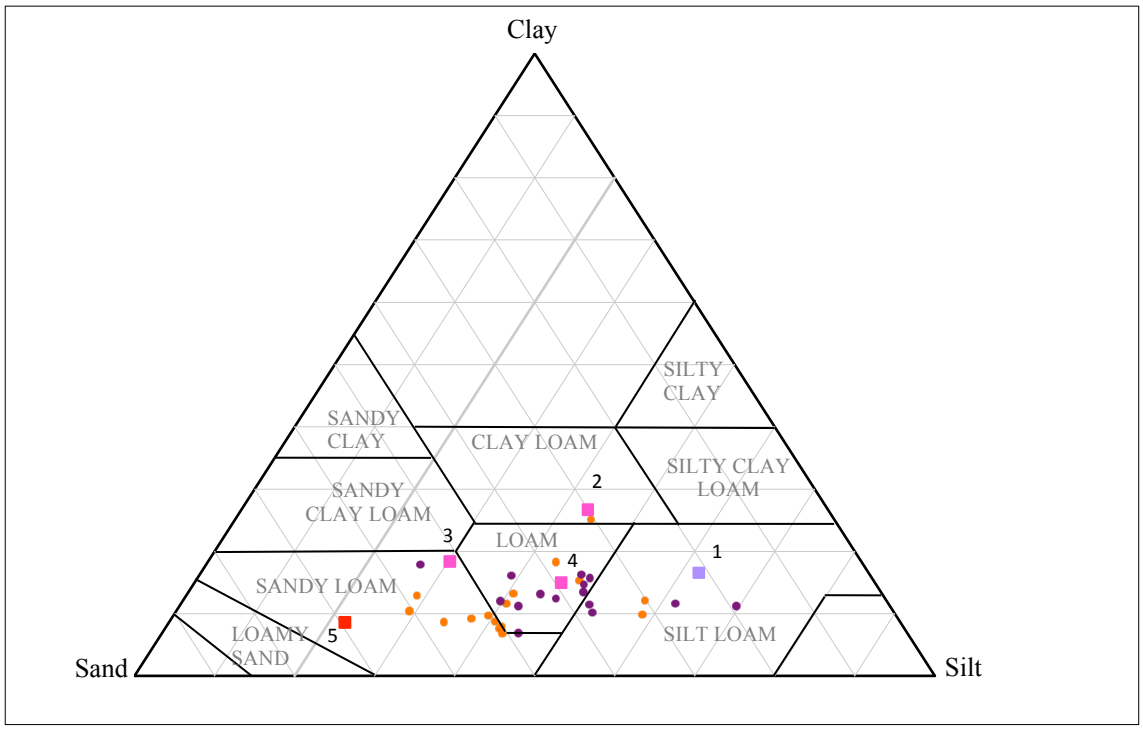


Fig. 1. Ternary graph showing additional ancient brick samples from Hierakonpolis based on grain size distribution with two major groups from the Fort, orange corresponds to Phase 1 group, purple to Phase 2; (1) Temple, (2) Tomb 10 HK.BL.2, Recipe A (3) Tomb 10 HK.BL.3, Recipe B (4) Tomb 30 HK.BL.1, (5) Mastaba

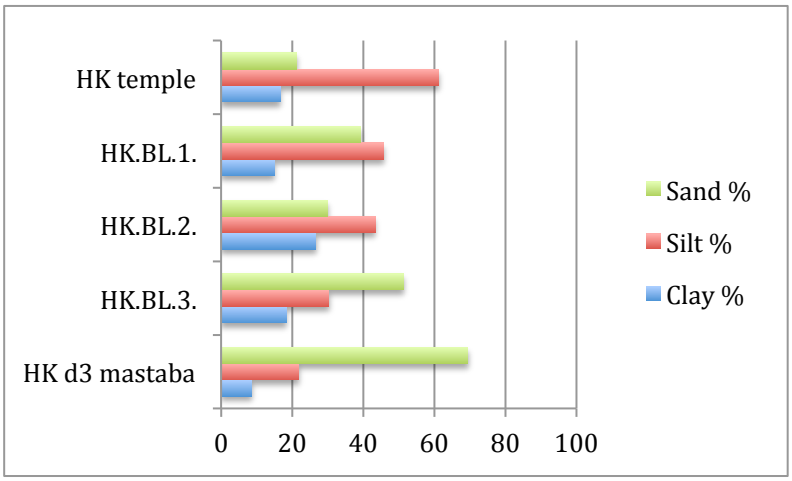


Fig. 2. Bar chart showing the grain size distribution of the additional samples from Hierakonpolis

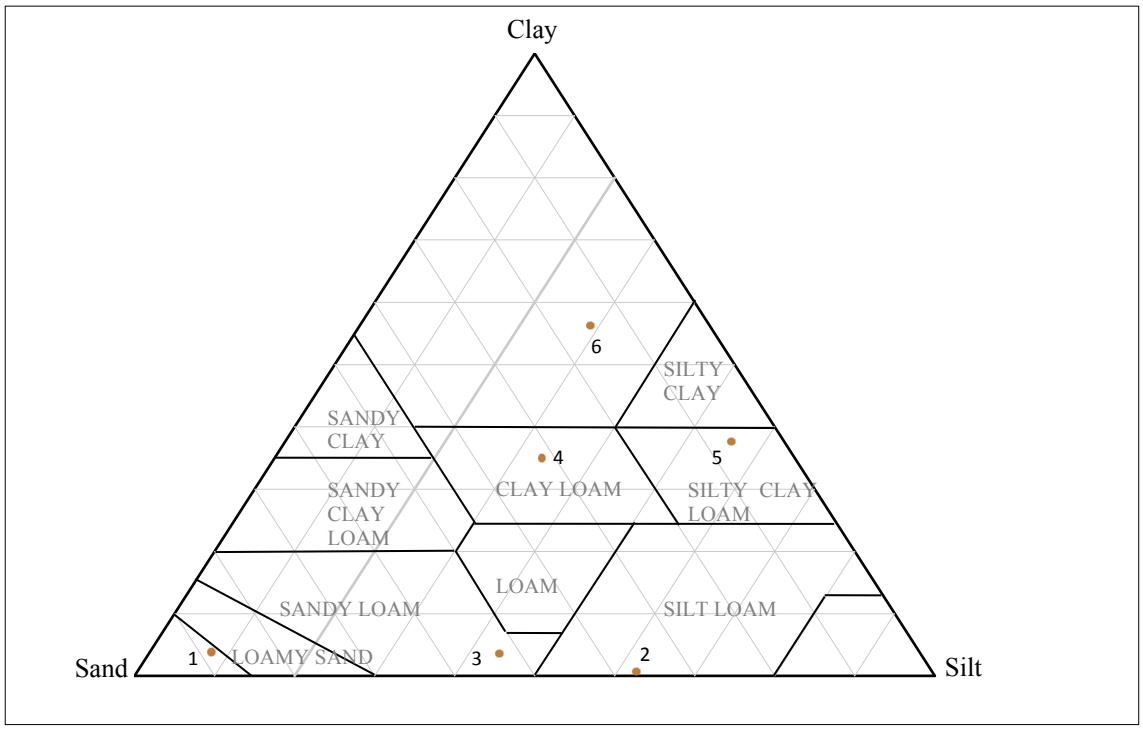


Fig. 3. Ternary graph showing texture of environmental samples from Hierakonpolis based on grain size distribution (1) wadi wash, (2) Sahaba Silts 1, (3) Sahaba Silts 2, (4) Silt Pit 1, (5) Silt Pit 2, (6) Field Top Soil

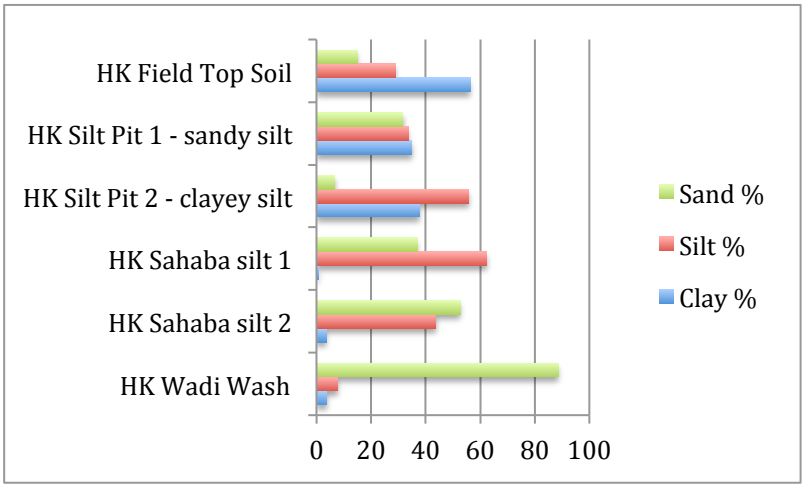


Fig. 4. Bar chart showing the grain size distribution of the environmental samples from Hierakonpolis

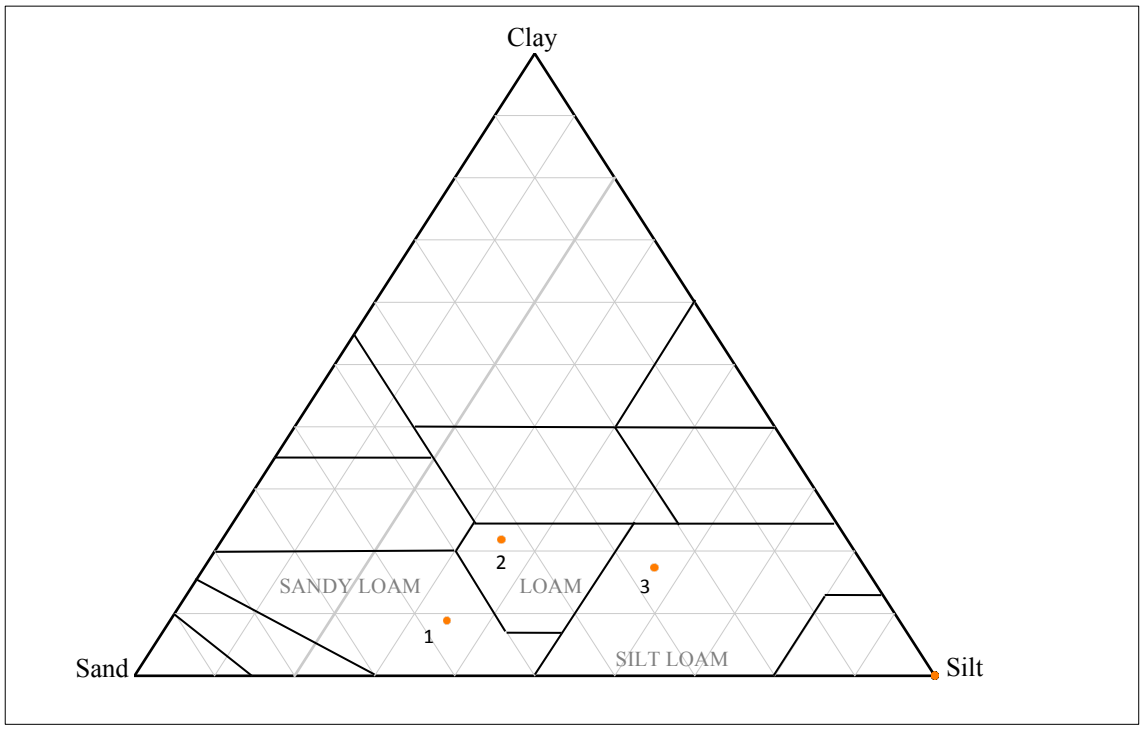


Fig. 5. Ternary graph showing texture of modern brick samples from Hierakonpolis based on grain size distribution; (1) Modern Sand Brick, (2) Modern Fort Brick, (3) Modern Pure Field Earth Brick

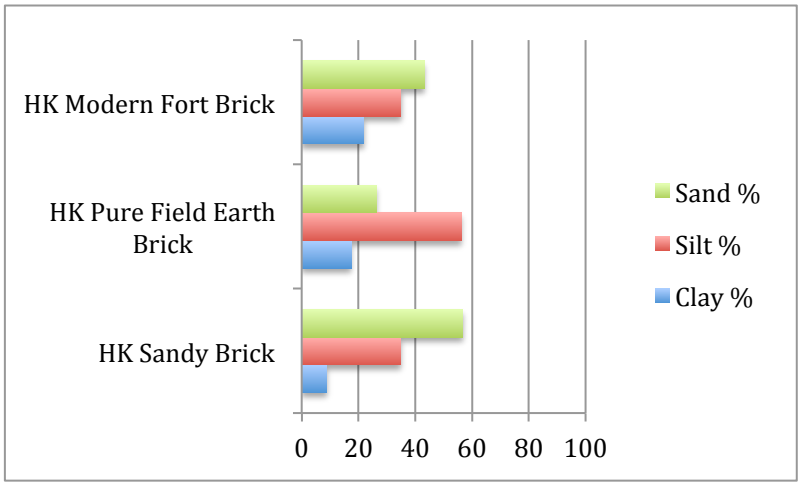
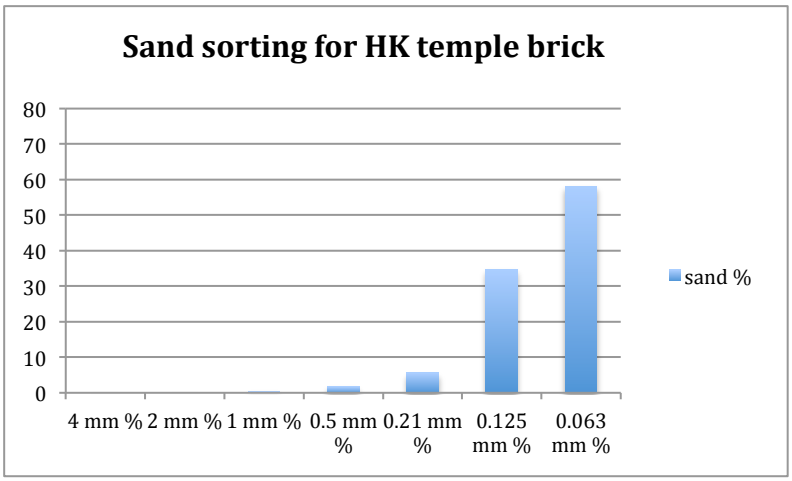


Fig. 6. Bar chart showing the grain size distribution of the modern brick samples from Hierakonpolis.

Fig. 7. (Top) Picture of Tomb 10 HK6, Hierakonpolis; (bottom) close up picture of Tomb 10 bricks (from the author)

Fig.8. (Top) Picture of Tomb 30, HH6, Hierakonpolis; (bottom) picture of the stack of bricks that the sample was taken from (from the author)



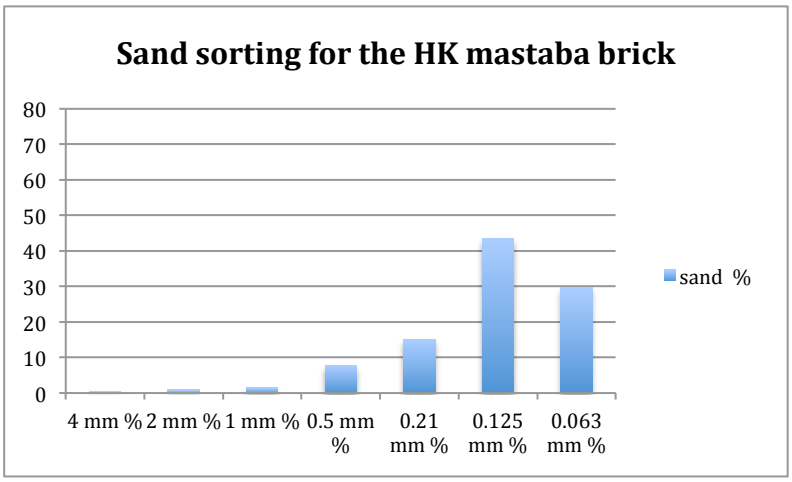


Fig. 9a. Charts showing sand sorting for the Temple and mastaba at Hierakonpolis

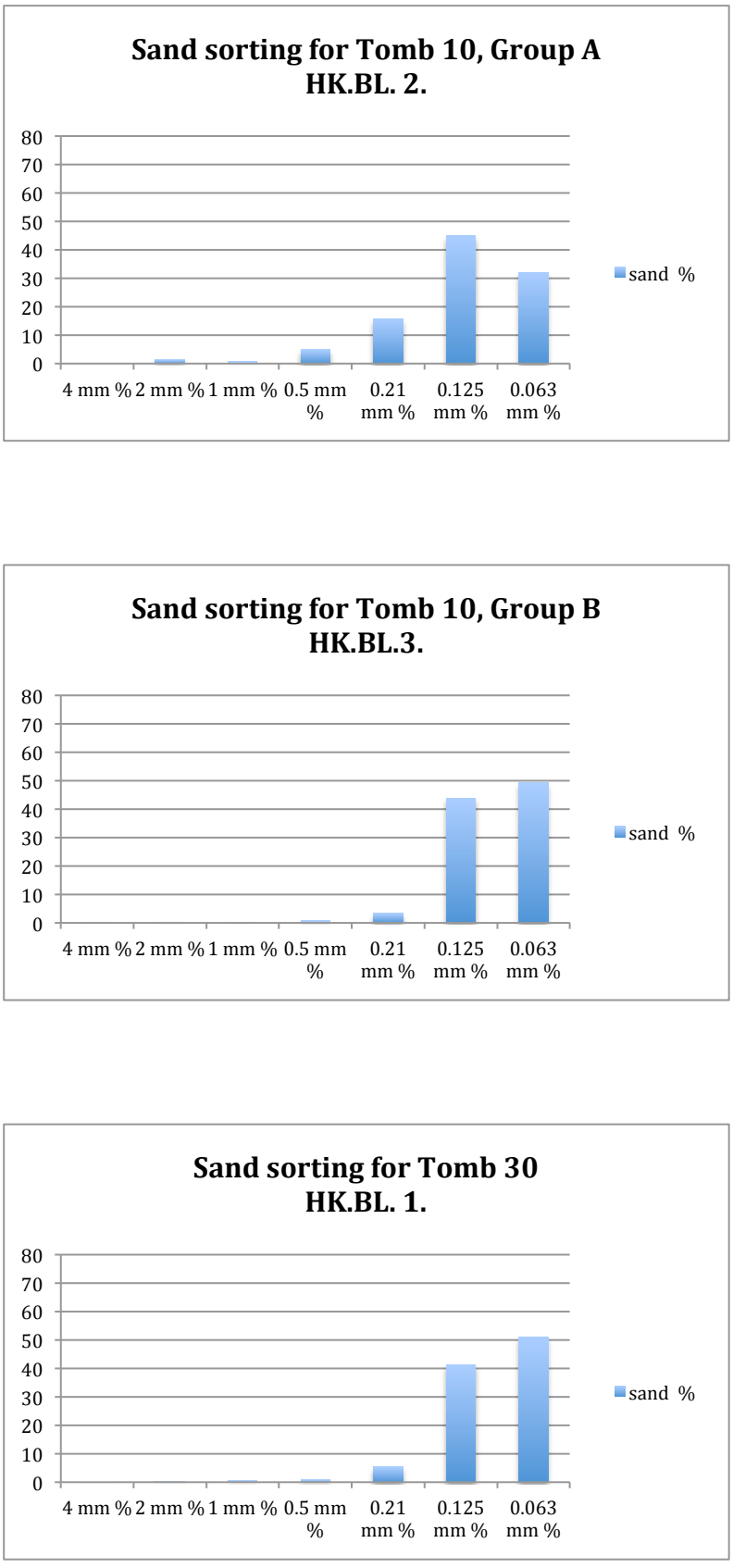
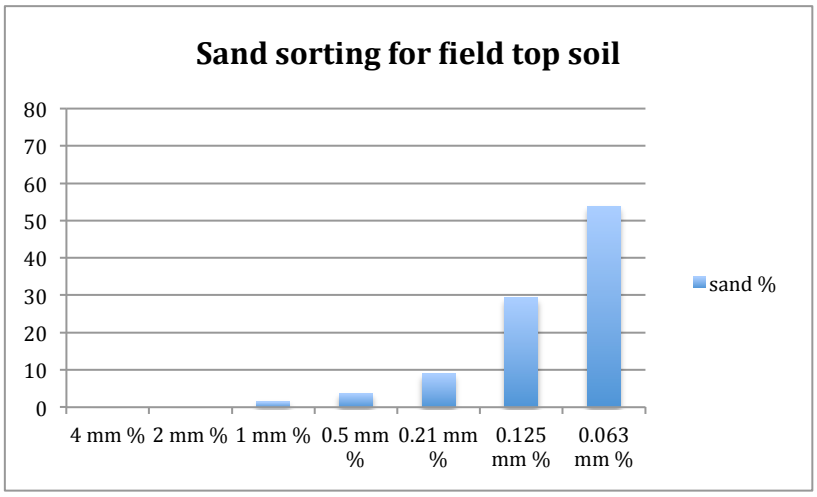
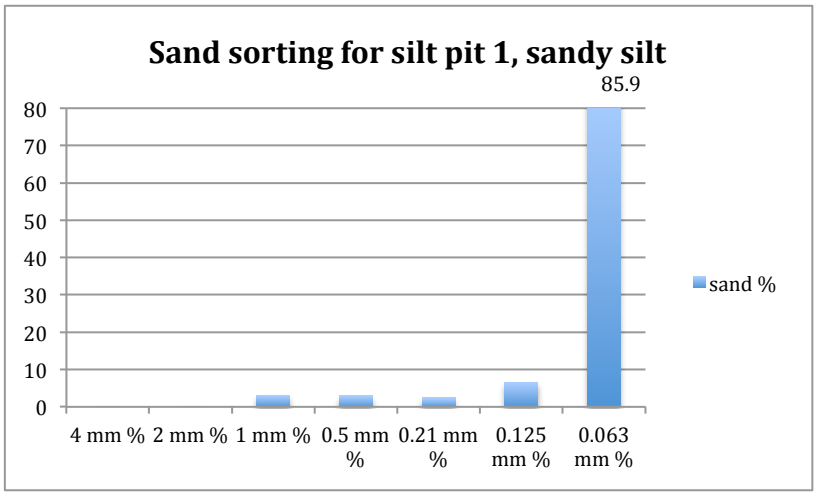


Fig. 9b. Charts showing sand sorting for Tombs 10 and 30, HK 6, Hierakonpolis





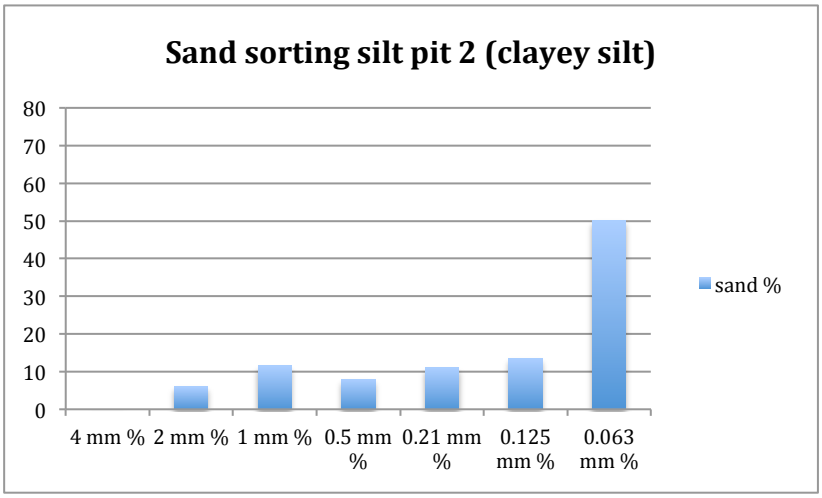
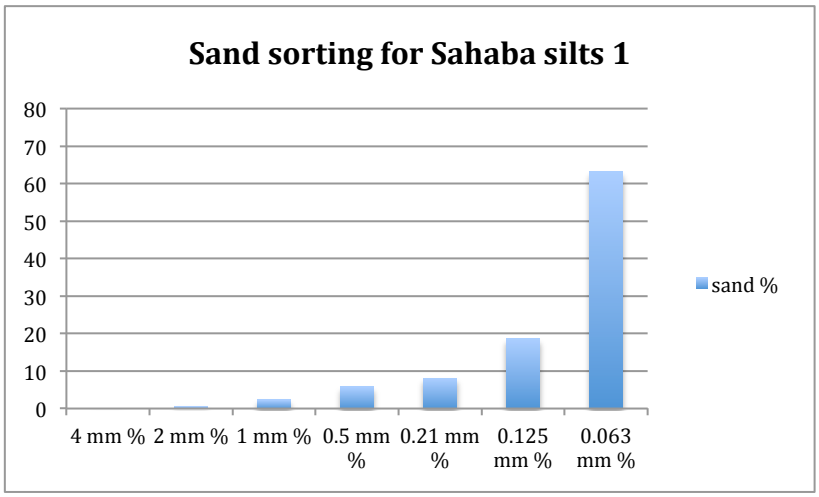
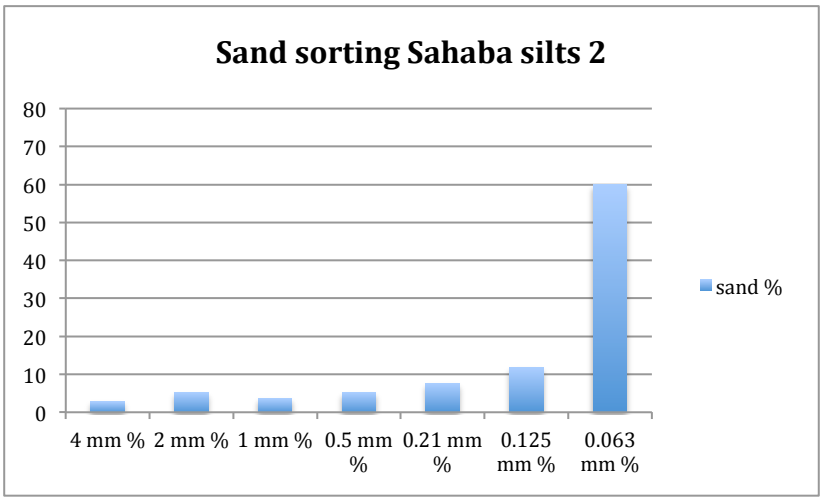


Fig. 9c. Charts showing the sand sorting for environmental samples from Hierakonpolis





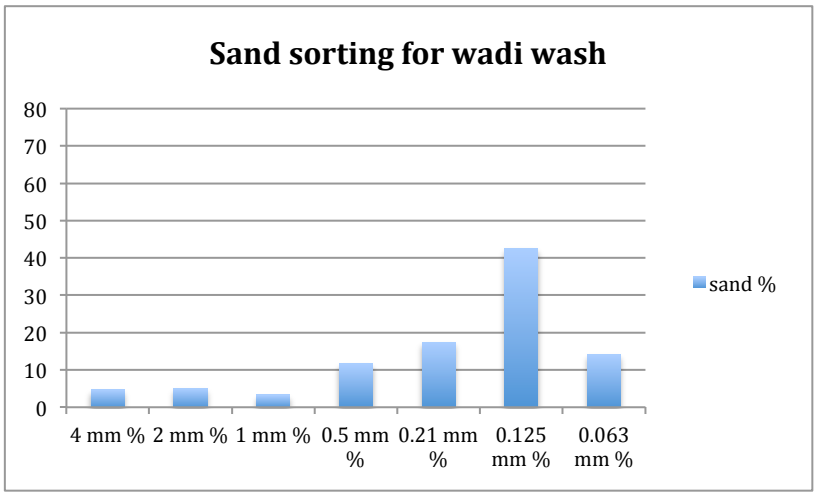
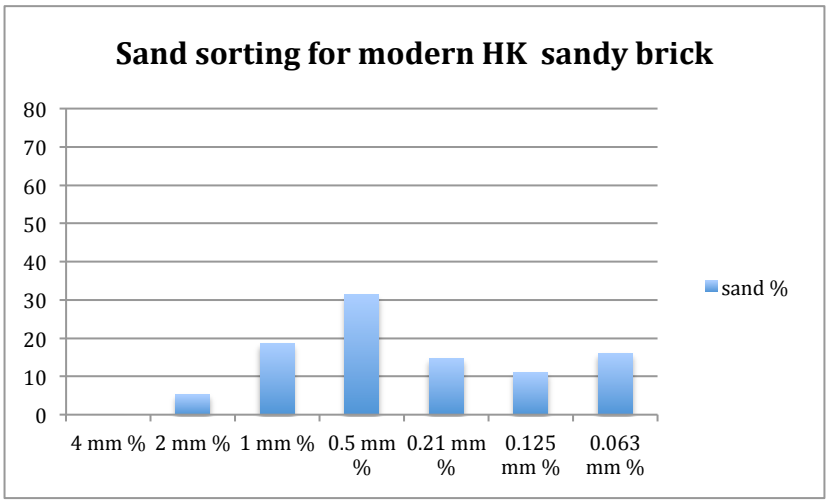


Fig. 9d. Charts showing the sand sorting for environmental samples from Hierakonpolis



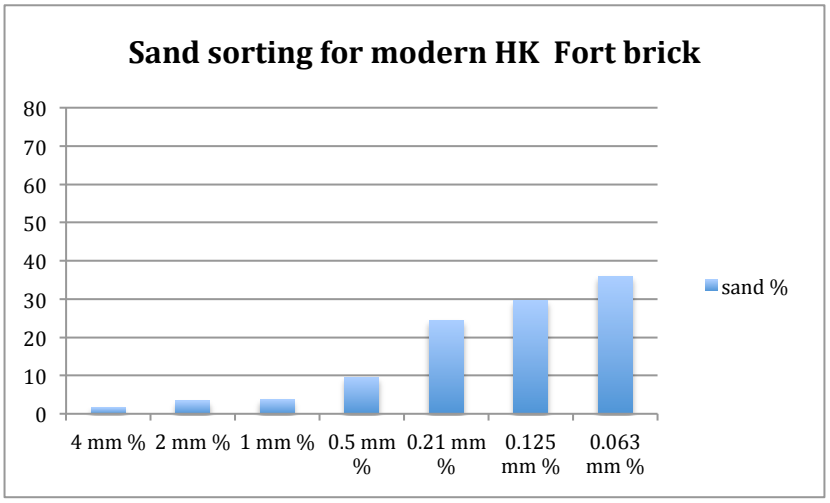


Fig. 9e. Chart showing the sand sorting for modern sandy brick and the brick recipe used for conservation of the Fort at Hierakonpolis (the sorting analysis for the pure field earth brick sample could not be performed and is therefore not included).

APPENDIX D:

DATABASES

King	*Site*	*Travertine*	*Gneiss*	*Pink Granite*	*Granodiorite*	*Basalt*
Khasekhemwy	Hierakonpolis	-	-	Incised door jamb & lintel	-	
Djoser	Saqqara	1 Paving in first burial chambers' (main & south tomb)	1 Paving in first burial chambers' (main & south tomb)	Wall lining, paving & portcullis in 2 burial chambers	-	Mortuary Temple wall lining/paving?
Sekhemkhet	Saqqara	-	-	-	-	-
Khaba	Zawyet el-Aryan	-	-	-	-	-
Huni?	Abu Rawash	-	-	-	-	-
Huni?/Snefru Meydum	Meydum	-	-	-	-	-
Snefru Bent	Dahshur	-	-	-	-	-
Snefru North	Dahshur	-	-	(Mortuary Temple false door)	-	-
Khufu	Giza	-	-	Burial chamber wall lining, 3 portcullises relieving chamber beams, mortuary temple columns	-	Mortuary temple & valley temple paving, harbour wall lining
Djedefre	Abu Rawash	-	-	Tomb casing 20 lower courses, burial chamber wall lining	-	-
Khafre	Giza	Mortuary temple wall lining 2 chambers, mortuary temple & valley temple paving, channels valley temple	-	Tomb casing 2 lower courses, entrance passage, mortuary temple, valley temple, causeway wall lining, 2 portcullis, mortuary & valley temple columns	Valley Temple, few wall blocks	-
Nebka	Zawyet el-Aryan	-	-	Burial chamber wall lining	-	-
Menkaure	Giza	-	-	Tomb casing 16 lower courses, burial chamber & mortuary temple casing, 3 portcullis	Few blocks in Mortuary Temple wall lining	-
Shepseskaf	South Saqqara	-	-	Tomb casing lower courses, burial chamber & passages lining, 3 plugging blocks	-	-

Architectural use of hard stones in Old Kingdom royal mortuary complexes

King	*Site*	*Mudbrick*	*Soft Limestone*	*Fine Limestone*	*Travertine*	*Granite*	*Granodiorite*	*Anorthosite Gneiss*	*Basalt*
Khasekhemwy	Abydos	X	X						
	Abydos	X							
	Hierakonpolis	X				X			
	Saqqara	X	X	X					
Djoser	Saqqara	X	X	X	X	X		X	(X)
Sekhemkhet	Saqqara		X	X					
Khaba	Zawyet el-Aryan		X	(X)					
Unknown	Abu Rawash	X	X						
Unknown/Huni?	Meydum	X	X	X					
Snefru MDM	Meydum	X	X	X					
Snefru Bent	Dahshur	X	X	X		X			
Snefru North	Dahshur	X	X	X		X			
Khufu	Giza		X	X	X	X			X
Djedefre	Abu Rawash	X	X	X	X	X	X		
Khafre	Giza		X	X	X	X	X		
Nebka	Zawyet el-Aryan		X			X			
Menkaure	Giza	(X successor)	X	X	X		X		
Shepseskaf	S. Saqqara	X	X				X		

Use of different materials in royal mortuary complexes from Khasekhemwy to Shepseskaf

Horus Name	*Horus Name Meaning*	*Nomen*	*Nomen Meaning*	*Nebti Name*	*Nebti Name Meaning*	*Golden Falcon*	*Golden Falcon Name Meaning*	*RMC Name*
Khasekhemwy	Horus of the Two Powers Come Forth	na	na	unknown	unknown	unknown	unknown	unknown
Djoser	Horus of the Divine Body	na	na	Nebti Netejri.Xt	The Two ladies Divine of Body	Nbw	the golden one	unknown
Sekhemkhet	Hous who Flourishes the Two Lands or Horus Strong of Body	na	na	unknown	unknown	unknown	unknown	unknown
Khaba	Horus's Soul Appears	na	na	unknown	unknown	(Bik) Nbw?	the Golden (Falcon)?	unknown
unknown ruler	unknown	unknown ruler	unknown	unknown	unknown	unknown	unknown	unknown
Neb-maat	Horus Lord of Ma'at	Snefru	He of beauty	Neb-maat-nebti	The Two Ladies, Lord of Cosmic Order	Bik-nub	the Golden Falcon	Snefru endures
Neb-maat	Horus Lord of Ma'at	Snefru	He of beauty	Neb-maat-nebti	The Two Ladies, Lord of Cosmic Order	Bik-nub	the Golden Falcon	The Southern Shining Pryamid
Neb-maat	Horus Lord of Ma'at	Snefru	He of beauty	Neb-maat-nebti	The Two Ladies, Lord of Cosmic Order	Bik-nub	the Golden Falcon	The Shining Pyramid
Medjedu	Horus, the One Who Hits	Khnum-Khufu	Khnum protects me	Nebti-r-medjed	The One Who Hits for the Two Ladies	Bikwi-nub	The Two Golden Falcons	Khufu's horizon
Kheper	Horus has Become	Djedefre	Enduring like Re or Re is his support	Kheper-m-nebti	The One Who Became the Two Ladies	Biku-nub	The Golden Falcons/ The Two Golden Falcons	Djedefre's starry sky or Djedefre is the Sehed-Star
Weser-ib	Horus with the Strong Heart	Khafre	He appears like Re	Weser-m-nebti	The One Who is Strong with the Two Ladies	Netjer-nub-sekhem	Re has appeared Strong of Heart, Khafre	Khafre is great
unknown	unknown	Nebka	My Ka is my lord	unknown	unknown	unknown	unknown	?-ka is a star
Ka-khet	Horus whose Body is that of a Bull	Menkaure	The souls of Re are established/eternal	Ka-nebti	The Bull of the Two Ladies	Netjeru-nub-netjeri	The Divine Golden Falcon	Menkaure is Divine
Shepses-khet	Horus whose Body is Pure	Shepseskaf	Horus whose body is noble/pure	Shepses-nebti	The Noble One of the Two Ladies	unknown	unknown	Shepseskaf is purified

Royal Nomenclature

King	*Site*	*Valley Temple Dimension*	*Causeway Axis*	*Causeway Dimension*	*Causeway Wall Width*	*Causeway Slope*	*Enclosure Dimension*	*Enclosure Surface m3*	*Enclosure Wall Width*	*Mortuary Temple Location*	*Mortuary Temple Axis*	*Mortuary Temple Dimension*	*Mortuary Temple Surface*	*South Tomb*	*South Tomb Relation to Enclosure*
Khasekhemwy	Abydos	18 x 15 (chapel)	NS	2,000	na	< 1°	127 x 65 x 11	8,255	5	na	na	na	na	na	na
Djoser	Saqqara	na	na	na	na	na	544 x 277 x 10.5	150,965	?	N	EW	unknown	unknown	S	in
Sekhemkhet	Saqqara	na	na	na	na	na	500 x 185	92,500	-	N	EW (?)	na	na	S	in
Khaba	Zaeyet el-Aryan	na	na	na	na	na	na	na	na	na	na	na	na	na	na
Unknown	Abu Rawash	na	na	na	na	na	na	na	na	na	na	na	na	na	na
unknown/Hun?i	Meydum	na	SE-NW	760 x 4	1.6-1.9	9°	290 x 150 ?	43,500 ?	10 ?	na	na	na	na	na	na
Snefru Meydum	Meydum	na	EW	210 x 7	4.5	9°	236.22 x 215.8	50,983.36	1.45	E	EW	9.18 x 9	82.62	S	in
Snefru Bent	Dahshur	47.16 x 26.2	NE-SW	704 x 6.9	1.9	4°	299 x 299	89,400	2	E	EW	9.5 x 7.5	640	S	in
Snefru North	Dahshur	100 x 65	EW	na	na	na	-	-	-	E	EW	60 x 50	3,000	S?	na
Khufu	Giza	50 x 50 (?)	NE-SW	660 x 9	2	15°, 5°	252 x 252	63,504	3.15	E	EW	52 x 43	2,200.80	SE	out
Djederfre	Abu Rawash	unknown	NE-SW	1700 x 14	1.65	5°	426 x 220	93,720	2.6	E	NS	65 x 35	875	SE; converted in Q tb	in
Nebka?	Giza	na	EW	na	na	na	465 x 420 (?)	195,300	-	no trace	na	-	-	na	na

Royal Mortuary Complex Architectural Design

King	*Site*	*Valley Temple Dimension*	*Causeway Axis*	*Causeway Dimension*	*Causeway Wall Width*	*Causeway Slope*	*Enclosure Dimension*	*Enclosure Surface m3*	*Enclosure Wall Width*	*Mortuary Temple Location*	*Mortuary Temple Axis*	*Mortuary Temple Dimension*	*Mortuary Temple Surface*	*South Tomb*	*South Tomb Relation to Enclosure*
Khafre	Zawyet el-Aryan		EW	494.6 x 9	2	-	-	-	-	E	EW	-	-	S	-
Menkaure	Giza	70 x 50	EW	608 x 7	2	-	-	-	-	E	EW	-	-	S; converted into Q tb	out
Shepseskaf	Saqqara	unknwon	EW	760 x 1.7	1.2	-	-	-	3.3	E	NS	-	-	0	na

Royal Mortuary Complex Architectural Design (continued)

LIST OF COORDINATES

RMC Local Quarries

Quarry	*Northing*	*Easting*
Khasekhemwy ABD tomb Q1	26°12'14"N	31°52'33"E
Khasekhemwy ABD tomb Q2	26°11'45.02"N	31°51'57.03"E
Khasekhemwy Gisr el-Mudir North quarries	29°52'11.85"N	31°12'20.28"E
	escarpment west?	escarpment west?
Djoser	Escarpment, dry moat	Escarpment, dry moat
Sekhemkhet	Unknown	
Khaba	29°56'3.00"N	31° 9'45.56"E
AR mudbrick pyramid	n/a	n/a
Meydum Quarries 1	29°23'6.52"N	31° 9'26.93"E
Meydum Quarries 2?	29°22'54.43"N	31° 9'24.33"E
Bent	29°47'24.31"N	31°12'43.42"E
North quarry 3	29°47.3'	31°12.0'
North Quarry 2	29°48'11"N	31°11'50"E
North Quarry 1	28°48'00"N	31°11'27"E
Khufu/Khafre Quarries	29°58'23.83"N	31° 7'53.94"E
Djedefre Wadi quarries	30°03'	31°04'
Khafre	29°58'23.83"N	31° 7'53.94"E
Nebka (pit)	29°56'24.61"N	31° 9'5.72"E
Menkaure	29°58'6.00"N	31° 7'48.00"E
Shepseskaf	29°49'36.00"N	31°11'12.00"E

Stone Quarries

Site	*Northing*	*Easting*
Saqqara Escarpment Quarries	29°52'40.13"N	31°13'20.77"E
Saqqara Dry Moat Quarries	29°52'9.00"N	31°12'54.00"E
Saqqara West Quarries (Aston et al. 1994)	29°50'54.00"N	31° 9'54.00"E
Tura start series	29°56.6	31°18.4
Maasara end series	29°53.6	31°21.1
Mokattam	3001.9	3106.1
Wadi Gerrawi	29°48'41.42"N	31°27'14.16"E
Hatnub	27°33'18.00"N	31° 1'18.00"E
Gebel Qatrani Basalt Quarries	29°40'0.00"N	30°37'0.00"E
Aswan granite quarries	24° 3'37.54"N	32°53'40.43"E
Gebel el-Asr	22°46'0.00"N	31°13'0.00"E

Abu Rawash Djedefre Pyramid Coordinates

Features	*Coordinates*	*Elevation*
pyramid entrance	30° 01' 57"	154m +- 7
	31° 04' 30"	
pyramid centre	30° 01' 56"	150m
	31° 04 29"	
outer enclosure entrance	30° 02' 01"	152m
	31° 04' 29/30"	
pyramid NW corner	30° 01' 57"	163m +- 4
	31° 04' 28"	
pyramid NE corner	30° 01' 57"	162m +- 5
	31° 04' 32"	
pyramid SE corner	30° 01' 55"	167+- 5
	31° 04' 32"	
pyramid SW corner	30° 01' 54"	160m +- 4
	31° 01' 53"	

Giza Coordinates

PYRAMIDS

KING	*NW*	*elevation*	*NE*	*elevation*	*SE*	*elevation*	*SW*	*elevation*
Khufu	29° 58' 49"	64 +-7	29° 58' 48"	60 +-6	29° 58' 41"	66 +- 5	29° 58' 41"	64 +- 10
	31° 07' 59"		31° 08' 07"		31° 07' 07"		31° 07' 59"	
Khafre	29° 59' 42"	64 +- 5	29° 58'		29° 58' 30"	68 +- 7	29° 58' 30"	69 +- 6
	31° 08' 59"		31° 08'		31° 08' 55"		31° 08' 41"	
Menkaure	29° 58' 23"	74m +- 7	29° 58' 23"	77m +- 5	29° 58' 19"	76m +- 4	29° 58' 19"	75m +- 6
	31° 08' 40"		31° 08' 44"		31° 08' 44"		31° 08' 40"	

SATELLITE PYRAMIDS

King	*NW*	*elevation*	*NE*	*elevation*	*SE*	*elevation*	*SW*	*elevation*
Khufu	29° 58' 41"	62m +-4	29° 58' 41"	62m +-4	29° 58' 40"	62m +-4	29° 58' 41"	62m +-3
	31° 08' 08"		31° 08' 09"		31° 08' 09"		31° 08' 08"	

MORTUARY TEMPLES

KING	*C entrance*	*elevation*
Khufu	29° 58' 45"	63m +-6
	31° 08' 04"	
Khafre	29° 58' 33"	60m +-6
	31° 07' 59"	
Menkaure	29° 59' 21"	74m +-13
	31° 07' 46"	

CAUSEWAYS

KING	*valley temple*	*elevation*	*midway*	*elevation*	*mortuary temple*	*elevation*
Khufu	29° 58' 47"	53m +-5	29° 58'		29° 58' 45"	63m +-6
	31° 08' 18"		31° 08'		31° 08' 04"	
Khafre	29° 58' 33"		29° 58' 32"	47m +- 47	29° 58'	
	31° 08' 59"		31° 08' 06"		31° 08'	
Menkaure	29° 58' 21"	43m +-3	29° 58'		29° 58' 21"	75m +-5
	31° 07' 59"		31° 08'		31° 07' 47"	

VALLEY TEMPLES

KING	*NW*	*elevation*	*NE*	*elevation*	*SE*	*elevation*	*SW*	*elevation*	*harbour*	*c. elevation*
Khufu	NA		NA		NA		NA		NA	
Khafre	29° 59' 30"	24m +- 10	29° 59' 30"	17m +- 11	29° 59' 28"	16m +- 8	29° 59' 28"	19m +- 12	29° 58' 29"	16m +- 12m
	31° 08' 17"		31° 08' 19"		31° 08' 19"		31° 08' 17"		31° 08' 20"	
Menkaure	NA		NA		NA		NA		NA	

QUEENS PYRAMIDS

PYRAMID	*NW*	*elevation*	*NE*	*elevation*	*SE*	*elevation*	*SW*	*elevation*	*entrance*	*elevation*
Khufu GI-a	29° 58' 45"	63m +-5	29° 58' 45"	62m +-5	29° 58' 43"	64m +-6	29° 58' 43"	67m +-8	29° 58' 45"	63m +-5
	31° 08' 10"		31° 08' 11"		31° 08' 11"		31° 08' 10"		31° 08' 10"	
Khufu GI-b	29° 58' 43"	63m +-5	29° 58' 43"	62m +-5	29° 58' 41"	65m +-6	29° 58' 41"	74m +-8		
	31° 08' 10"		31° 08' 11"		31° 08' 11"		31° 08' 10"			
Khufu GI-c	29° 58' 41"	60m +-7	29° 58' 41"	64m +-5	29° 58' 40"	64m +-8	29° 58' 40"	51m +-8	29° 58' 41"	51m +-8
	31° 08' 09"		31° 08' 11"		31° 08' 11"		31° 08' 09"		31° 08' 10"	
Menkaure GIII-a	29° 58' 19"	69m +-4	29° 58' 18"	71m +-4	29° 58' 17"	70m +-7	29° 58' 17"	69m +-4		
	31° 07' 41"		31° 07' 43"		31° 07' 42"		31° 07' 41"			
Menkaure GIII-b	29° 58' 18"	66m +-4	29° 58' 18"	69m +-5	29° 58' 17"	62m +-5	29° 58' 17"	65m +-4		
	31° 07' 39"		31° 07' 41"		31° 07' 41"		31° 07' 34"			
Menkaure GIII-c	29° 58' 18"	67m +-4	29° 58' 18"	72m +-4	29° 58' 17"	70m +-5	29° 58' 17"	69m +-4		
	31° 07' 38"		31° 07' 39"		31° 07' 39"		31° 07' 38"			

SAQQARA

PYRAMID	*NW*	*elevation*	*NE*	*elevation*	*SE*	*elevation*	*SW*	*elevation*
Sekhemkhet	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown
Djoser	29° 52' 18"	53m +-4	29° 52' 18"	59m +-5	29° 52' 15"	59m +-4	29° 52' 15"	58m +-5
	31° 12' 58"		31° 13' 02"		31° 13' 02"		31° 134 58"	

DAHSHUR

PYRAMID	*NW*	*NE*	*SE*	*SW*	*entrance*
North Pyramid	29° 48' 34"	29° 48' 34"	29° 48' 28"	29° 48' 28"	29° 48' 33"
	31° 12' 18"	31° 12' 26"	31° 12' 26"	31° 12' 19"	31° 12' 23"
Bent Pyramid	29° 47' 28"	29° 47' 28"	29° 47' 22"	29° 47' 22"	29° 47' 28"
	31° 12' 30"	31° 124 38"	31° 12' 38"	31° 12' 31"	31° 12' 34"

MORTUARY Chapel

PYRAMID	*entrance'*	*votive area*
North Pyramid	29° 48' 31"	29° 48' 31"
	31° 12' 28"	31° 12' 27"
Bent Pyramid	29° 47' 25"	29° 47' 25"
	31° 12' 38"	31° 12' 38"

SATELLITE PYRAMIDS

PYRAMID	*NW*	*NE*	*SE*	*SW*
North Pyramid	NA	NA	NA	NA
Bent Pyramid	29° 47' 20"	29° 47' 20"	29° 47' 19"	29° 47' 19"
	31° 12' 33"	31° 12' 35"	31° 12' 35"	31° 12' 33"

VALLEY TEMPLE

PYRAMID	*entrance*
Bent Pyramid	29° 47' 21"
	31° 13' 01"

MEYDUM

PYRAMID	29° 24' 12"
	31° 07' 02"

MINOR STEP PYRAMIDS

SITE	*Northing*	*Easting*
Abu Rawash ?	30° 2'57.17"N	31° 5'10.86"E
Seila	29°22'38.04"N	31° 3'10.56"E
Zawyet el-Meytin	28° 2'45.34"N	30°49'44.37"E
Abydos		
Naqada/Nubt/Ombos		
Hierakonpolis/el kula	25° 8'0.92"N	32°44'1.22"E
Edfu		
Elephantine	24° 5'5.97"N	32°53'8.50"E

OTHER SITES

SITE	*Northing*	*Easting*
Heliopolis - Senwoseret III obelisk	30° 07' 46"	31° 18' 27"
Aswan (low dam)	240207	325218
Elephantine	240524	325322

Visual Description of Mudbricks from Khasekhemwy's Enclosure at Abydos

Sample	*Sample Type*	*Sample Location*	*Colour*	*Munsell Colour (Wet)*	*Paste Mixture*	*Texture/Composition*	*Organic Temper*
AB.K.S.1	typ. Brick	encl. S wall, int.	very dark grayish brown	2.5 YR 3/2	homog.	v hard	chaff, little left, mostly impressions, well mixed
AB.K.E.2	typ. brick	encl. E wall	dark grayish brown	10 YR 4/2	homog.	no comment	a lot, chaff, well mixed; bh, termite excrements
AB.K.E.1	typ. brick	encl. E wall	very dark grayish brown	10 YR 3/3 - 3/2	homog.	v hard	chaff, mostly horizontal
AB.K.PW.S.1	typ. brick	perim. wall, S wall	very dark grayish brown	10 YR 3/2	homog.	micaceous	chaff, a lot; some very large org like other bricks
AB.K.PW.S.3	typ. brick	perim. wall, S wall	very dark grayish brown	10 YR 3/2	homog.	no comment	chaff, a lot; some very large organics like in other bricks
AB.K.PW.S.2	typ. brick	perim. wall, S wall	very dark grayish brown	10 YR 3/2	homog.	coarse sandy feel; poss sedi layers, some very pale brown coarse sand though could be later aeolian deposits in insect bh	chaff, less than other brick, impressions
AB.K.S.2	typ. brick	encl. S wall, ext.	very dark grayish brown	2.5 YR 3/2	homog.	v hard	chaff, little left, mostly impressions, well mixed
AB.K.W.2	typ. brick	encl. W wall	very dark grayish brown	10 YR 3/2	homog.	some v large coarse sand with poss begin of dv but not looking at it under microscope, ps, sa qtz	chaff, a lot, mostly horizontal, though not all, some at 45 degree angle
AB.K.PW.S.4	typ. brick	perim. wall, S wall	very dark grayish brown	10 YR 3/2	homog.	coarse sandy feel	chaff, impressions, less than in AB.K.PW.S.3
AB.K.W.1	typ. brick	encl. W wall	dark grayish brown	10 YR 3/2	homog.	no comment	chaff
AB.K.N.1	typ. brick	encl., N wall	very dark grayish brown	10 YR 3/2	homog.	coarse sandy feel; some wisps of very brown, cld be aeolian inclusions in bh	v little org temper left, few impressions, bh
AB.K.CB.S.3	typ. brick	cult building, S wall	dark grayish brown	10YR 4/2	homog.	coarse sandy feel	a lot of chaff in all directions; possible distinction btn chaff and manure (pic)
AB.K.CB.S.2	rare brick	cult building, S wall	yellowish brown	10 YR 5/4	homog.	coarse sandy feel	a lot of chaff, poss manure, impressions, bh
AB.K.CB.S.1	rare brick	cult building, S wall	very dark gray	7.5 YR 3/1	homog.	coarse sandy feel similar to some of the HK bricks	remains of chaff, impressions, bh

Grain Size Distribution and Sand Sorting of Mudbricks from Khasekhemwy's Enclosure at Abydos

Sample	*Clay %*	*Silt %*	*Sand %*	*4 mm %*	*2 mm %*	*1 mm %*	*0.5 mm %*	*0.21 mm %*	*0.125 mm %*	*0.063 mm %*	*Sorting*
AB.K.S.1	3.7	74.3	22	0	0	0.3	1.3	7.5	33.9	53.2	vw
AB.K.E.2	5.2	74.4	20.4	0	1.5	1	2.5	4.9	12.2	77	w-vw
AB.K.E.1	5.3	71.9	22.8	0	1	1.6	4.8	10.1	23	59.5	m-p
AB.K.PW.S.1	8.4	73.5	18.1	0	0	0	0.9	2.4	16.1	79.3	w-vw
AB.K.PW.S.3	6.9	76.8	16.3	0	0.8	1.6	3.7	7.2	22.5	63.7	w
AB.K.PW.S.2	8.8	70.8	20.4	0	0	0	1.6	4.3	18.8	73.8	vw
AB.K.S.2	11.5	74	14.5	0	0	0	5.1	7.3	16.2	67.9	w
AB.K.W.2	14.5	64	21.4	2	6.1	3.8	4.9	13.2	34.7	32.8	p
AB.K.PW.S.4	7.6	57	35.4	0	0	0.4	2.4	7.5	20.3	51.8	w*
AB.K.W.1	9.6	62	28.5	0	0.6	1.5	3.4	15.6	5.6	48.3	m-p*
AB.K.N.1	15.5	46	38.4	2.7	5.2	2.2	3.4	25	38.7	20.7	p
AB.K.CB.S.3	15.9	50.8	33.2	0	0	0.4	3.6	6.6	31.4	58.7	w
AB.K.CB.S.2	7.8	50.6	41.6	0	0	0.08	1.6	7.5	18	71.4	w
AB.K.CB.S.1	11.5	41.2	48.5	0	0.3	0.5	10.3	25.4	32.6	25.8	p*

Sample	*4 mm*	*2 mm*	*1mm*	*0.5 mm*	*0.21 mm*	*0.125 mm*	*0.063mm*	*Comments*
AB.K.S.1	NA	NA	50 % concretion	50 % concretion; < 2 % red ceram.; qtz dv, sr-r	20 % concretion; 5 % red ceram.; 2 % bone; 2 % charcoal; mica; qtz dv, ls, a-sr	10 % concretion/ceram.; 10 % qtz a, ls; mica; <2% charred bone; green slightly translucent rock; 1 greenish faience	10 % concretion/ceram.; 10 % qtz a, ls; mica; < 2 % charred bone; green slightly translucent rock; 1 greenish faience	a lot of chaff manure-like
AB.K.E.2	NA	50 % gray ceram.	50 % gray ceram.	50 % gray ceram.; 5 % qtz dv, facets, r-sr, hs	50 % ceram.; 5 % qtz r-sr, hs; mica	50 % ceram.; 2 % qtz; 2 % charcoal	40 % qtz a, hs; 20 % ceram.; < 2 % charcoal	some manure-like chaff
AB.K.E.1	NA	50% gray ceram	50% gray ceram	50% gray ceram; 2 % charcoal	30 % ceram.; 2 % qtz facets, ls, sr; < 2 % charcoal; rounded white bone	20 % ceramic; 2 % qtz; 2 % charcoal; mica	20 % ceramic; 2 % qtz; 2 % charcoal; mica	50 % manure-like org
AB.K.PW.S.1	NA	NA	NA	2 % qtz r, hs, dv, sr-r	5 % qtz hs, dv, sr-r; 2 % ceram.; < 2 % charcoal	40 % qtz hs, dv,increasingly a and less s; 5 % ceram.; 2 % charcoal	50 % qtz; 2 % ceram.; < 2 % charcoal; mica	manure-like chaff
AB.K.PW.S.3	NA	all ceram. 1 red, 3 gray	all ceram.	all ceram.	20 % ceram.; 10 % qtz a, ls, dv, facets; < 2 % charcoal; < 2 % mica	20 % ceram.; 20 % qtz dv, a; charred bone; 1 green faience-like colured rock similar to S1	20 % ceram.; 20 % qtz a, dv; charred bone; 1 green faience like colured rock? Mica	none
AB.K.PW.S.2	NA	NA	NA	< 2 % desert sand though could be later aolian dep esp given nature of sample; v similar to AB.K.S2 in organic content and simialr to HK traces of smaller charcoal	5 % ceram.; qtz sr-sa, facets; 2 % charcoal	30 % qtz dv, more angular; 2 % ceram.; 2% charcoal	50 % qtz; 2 % charcoal; 2 % ceram.; mica	chaff; mostly manure-like organics
AB.K.S.2	NA	NA	NA	5 % qtz r, dv, hs; 2% charred 4 mm long bones: fish?, 1 charred insect, 2 % ceram.	30 % chaff; 5 % ceram.; 5 % qtz dv, ms, facets sa-r; < 2 % mica & charcoal	10 % ceramic; 5 % qtz a; 2 % charcoal; mica	50 % qtz; 5 % charcoal; 2 % ceramic	a lot of chaff

Sand Description of Mudbricks from Khasekhemwy's Enclosure at Abydos

Sample	*4 mm*	*2 mm*	*1mm*	*0.5 mm*	*0.21 mm*	*0.125 mm*	*0.063mm*	*Comments*
AB.K.W.2	1 gray ceramic	50 % ceram./concretion (pic 2349); qtz a, facets	50 % ceram./concretion; qtz a, facets	charcoal; qtz a, facets	charcoal; qtz a, facets	charcoal; qtz a, facets	charcoal; qtz a, facets	a lot of fine chaff, so difficult to give exact ratios
AB.K.PW.S.4	NA	NA	mostly qtz dv, hs, sa-r	50 % qtz dv, hs, sr-r; < 2 % gray charred bone	50 % qtz; 2 % charred bone	50 % qtz ls dv; 2% charcoal (bone or stalks?); mica	50 % qtz; 2 % charcoal	mostly v fine manure-like orgs
AB.K.W.1	NA	2 concretion; ceram. Incl 1 red	50 % concretion; 2 r qtz; 1 red	50 % concretion; <2% blk & red ceram.; qtz with facets, hs, dv, r-sr	50 % qtz ls, a; 2 % ceram.; 2% concretion	40 % qtz; 2 % charcoal; 2 % concretion/ceram.	40 % qtz; 2 % charcoal; 2 % concretion/ceram.	a lot of chaff, v fine manure-like
AB.K.N.1	50 % gray ceram.	50 % gray ceram.; trace qtz sr, dv, 1 qtz ls; trace charred bone (chaff)	50 % gray ceram.; trace charred bone (chaff)	50 % gray ceram.; 5 % (hard to tell bc large amounts of chaff) qtz sr-r, hs, dv and facets	50 % qtz hs, increasingly sa; trace charcoal and rounded white bone; (a lot of chaff)	50 % qtz increasingly a and less hs; trace charcoal and ceramics; mica	50 % qtz increasingly a and less hs; < 2 % charcoal and ceramics; mica	N wall exposed to dominate winds could explain the increased amount of sand, esp. fine aeolian sands; manure-like content
AB.K.CB.S.3	NA	NA	mostly black ceram. ; trace qtz sr	50 % qtz hs, r-sr, facets w/ dv; 2 % ceram.	50 % qtz hs, more sa-sr, though facets w/ dv; 2 % ceram.	50 % qtz; maybe couple of charred bones/charcoal	50 % qtz; charred bones	1 large organic lightly charred on exterior + charcoal floating
AB.K.CB.S.2	NA	NA	2 limestone; 2 v fine gray ceram.; 1 bone (a little shiny/polished)	50 % qtz dv, sa-r; <2 % limestone; calcinated bone	50 % qtz, mostly hs; sr-r, dv; 2 % limestone; trace v fine gray ceram	50 % qtz; charcoal or black rocks? Mica	50 % qtz	large quantities of manure-like organics
AB.K.CB.S.1	NA	2 concretions (1 may be ceram.), 1 gray ceram. frag, 1 blackish fine grained angular rock	10 % ceram,. some v fine grained, 10 % qtz sr-r, 1s, dv; 2 % charcoal	50 % r qtz dv; hs; 2% fine ceram.; 2% charred bone/charcoal	50 % r qtz dv; hs; 2 % charcoal; 2 % ceram.	50 % r qtz dv hs; 2 % charcoal; 2 % ceram; trace mica	50 % r qtz dv hs; 2% charcoal; 2% ceram; trace mica	none

Sand Description of Mudbricks from Khasekhemwy's Enclosure at Abydos (continued)

Sample	*Sample Location*	*Munsell Colour Description*	*Munsell Colour (Wet)*	*Paste Mixture*	*Texture/Composition*	*Organic Temper*	*Charcoal*
HK.A.SW.2	SW wall, near corner	dark yellowish brown	10 YR 4/4 - 4/6	homog.	v fine sandy compact and homogenous texture	yes, trace orgs; bh	yes
HK.A.NW.1	NW wall, near N corner	dark grayish brown to brown	10 YR 4/4 - 4/3	heter. with sedi layers	compact feel; 2 % peds easy to break, v fine feel, pale brown 10 YR 7/3-4 and light yellowish brown 10 YR 6/4	yes, quite a lot though less than HKB bricks; honey coloured chaff with darker bits; coarse straw; impressions	yes < 1%, 0.1 cm
HK.A.SE.2	SE wall, close to ground level	brown	10 YR 4/3	heter 3 types of sedi layers	v dark lumps of 10 YR 3/2 and black 10 YR 2/1 rounded peds, 1.8 cm diam and grayish brown 10 YR 5/4 sandy soil around the peds (see pic)	yes, trace of chaff of varying lengths; 2 mm long; leaf?	yes, 0.5 cm diam
HK.A.NW.4	NW wall	very dark grayish brown	10 YR 4/2	heter. with sedi layers	yellow 10 YR 7/6 and brownish yellow 10 YR 6/6 sedi layers; some peds break easily; v hard red dry and brittle inclusions; 2 or 3 concretions c. 1.3 cm wide; v fine mica	yes, 5-10 % fine to larger in width 2 colours	yes, c. 0.1-0.2 cm < 1%
HK.A.SE.3	SE wall, near entrance "south corridor"	brown	10 YR 4/3	heter. with sedi layers	brown 10 YR 5/4 sandy sedi; dark grayish brown 10 YR 3/2 fine silty feel sedi ; large burnt sed, i wr	yes, more than sandy HKA bricks but less chaff and bh than HKB bricks	yes 0.1 cm diam
HK.A.NE.2	NE wall, centre, near ph A face, not deep, c. 11 courses agl	dark grayish brown	10 YR 3/2	heter. with sedi layers	v compact and hard feel; v dark brown 10 YR 2/2 sedi layers mixed with chunks of brown 10 YR 5/4 and yellowish brown sedi containing wr coarse translucent sand; peds	yes, 5-10 % light with darker bits, cut v fine	yes, quite a lot of charred chaff
HK.A.NE.3	NE wall, near N corner c 21 course agl, core	brown to dark grayish brown	10 YR 4/3-4/2	heter. with v distinct sedi layers	sandy; easy to break; v fine sand and cultural debris; fine to very fine layers c. 0.2 cm wide of yellowish brown 10 YR 5/4, yellower that Sahaba silts, run for at leats 9.0 cm of the sample; sedi layers v distinct; v hard red 2.5 YR 6/8 spotting (burnt sedi?); v dark brown peds 10 YR 2/2	yes, 2-10 %, chaff unevenly distributed , v fine < 0.3 cm with some rooty looking	yes, quite a lot of tiny specks; r charcoal near red spotting <1%
HK.A.SE.6	SE wall, higher courses than entrance samples	brown	10 YR 4/3	heter. with sedi layers	homogenous texture; sandy brown yellowish ped (1755); brown ped v similar to sandy silt form silt pit in both texture and colour	yes, though cannot see chaff; 1 v large straw (1752); v rare bh (1742-43); v fine org, poss manure?	everywhere, r 0.1 cm diam with long charred chaff

Visual Description of Mudbricks from Khasekhemwy's Enclosure at Hierakonpolis, Phase 1

Sample	*Sample Location*	*Munsell Colour Description*	*Munsell Colour (Wet)*	*Paste Mixture*	*Texture/Composition*	*Organic Temper*	*Charcoal*
HK.A.NE.4	NE wall	brown to dark grayish brown	10 YR 4/2 - 4/3	heter. with sedi layers	yellowish brown 10 YR 5/6 and v dark brown 10 YR 3/2 lumps; red orangish 2.5 YR 4/6 ceram.-like scatters, c 0.3 cm diam and 1 large c. 1cm diam	yes, trace	yes, ever few mm
HK.A.NW.5	NW wall, centre	brown	10 YR 4/3	heter. with sedi layers	lighter yellowish brown 10 YR 5/6 sedi layers; yellowish red 5 YR 4/6 spherical spotting that does not match any geological samples; 1 blue faience bead; small 0.1 cm dark reddish brown darker than 5 YR 2.5/2 and almost black angular lumps	yes, trace; v little bh	yes
HK.A.SW.1	SW wall	brown	10 YR 4/3	heter. paste with sedimentary layers	v hard and reacted "clayey" in water like the field earth; sedimentary layers of v dark grayish brown 10 YR 3/2 and yellowish brown 10 YR 5/6 soils (1915); red spotting: burnt sediment?	yes, quite a lot of chaff remains & impressions, more than in other bricks; few bh; 10% broken down organics, poss manure	yes, a lot and all different sizes
HK.A.NW.2	NW wall, centre	dark brown	10 YR 3/3	heter. with sedi layers	v tiny v dark gray 10 YR 3/1 lumps; harder red 2.5 YR 4/8 and 2.5 YR 5/ lumps that break into powder; small whitish crumbly inclusions; brown 10 YR 6/3 peds	yes, < 5 % chaff, v fine cut > 0.5 cm long honey and dark brown; trace of bh	yes, tiny frags, 1 large c. 0.2 cm
HK.A.SE.4	SE wall, close to central rubble but near the S corner	dark yellowish brown	10 YR 4/4	homog. with chunks of two sedi	chunks of light yellowish brown 10 YR 4/4 0.5 cm diam; v dark grayish brown peds 0.3 cm diam	yes, fine looking chaff	yes
HK.A.NE.6	NE wall, inside N corridor	brown	10 YR 4/3	heter. with sedi layers	sandy, same feel to d3 mastaba brick; faint v dark grayish brown layers (1877-78)	yes, trace; greenish chaff/manure	yes
HK.A.SE.5	SE wall, near entrance, "south corridor"	dark yellowish brown to brown	10 YR 4/2 - 4/3	homog. at 1st glance, though 2 sedi visible	lumps of a darker sedimentary layer with yellowish brown soils	yes, a lot of chaff, more chaff than sandy HKA bricks with some bh; a lot of fibrous org-like, poss manure; 1 large woody organic 0.21 mm	no
HK.A.NE.1	NE wall near entrance, poss from N corridor, agl	brown	10 YR 4/3	homog.	2 % v dark 10 YR 2/2 darker clumps + sharp angular peds	yes, 10-20 % v fine chaff + 20 % bh	yes

Visual Description of Mudbricks from Khasekhemwy's Enclosure at Hierakonpolis, Phase 1 (continued)

Grain Size Distribution and Sand Sorting of Mudbricks from Khasekhemwy's Enclosure at Hierakonpolis, Phase 1

Sample	*Clay %*	*Silt %*	*Sand %*	*4 mm %*	*2 mm %*	*1 mm %*	*0.5 mm %*	*0.21 mm %*	*0.125 mm %*	*0.063 mm %*	*Sorting*
HK.A.SW.2	6.8	42.6	50.6	0	0	0.1	0.3	3.7	41.2	52.6	w
HK.A.NW.1	7.6	41.8	50.6	NA	NA	NA	NA	NA	NA	NA	NA
HK.A.SE.2	7.9	41.9	50.2	0	0.8	0.5	2	6.4	35	52.5	w
HK.A.NW.4	8.8	40.4	50.6	NA	NA	NA	NA	NA	NA	NA	NA
HK.A.SE.3	9.2	37.5	53.3	5.5	0.8	0.4	1.5	5.6	34.5	49.2	mw-w
HK.A.NE.2	9.7	39.4	50.9	NA	NA	NA	NA	NA	NA	NA	NA
HK.A.NE.3	11.6	40.7	47.7	NA	NA	NA	NA	NA	NA	NA	NA
HK.A.SE.6	13.3	40.7	46	0	0	1.3	0.9	4.7	30.2	60.6	w
HK.A.NE.4	15.4	47	36.7	0	2	1.3	2	6.4	29.7	57.6	w
HK.A.NW.5	18.3	44.5	38.2	0	0.7	1	2.2	10.5	39.8	43.7	mw-w
HK.A.SW.1	25.1	44.5	30.4	0	0.9	1.3	2.7	6.5	37.5	48.8	w
HK.A.NW.2	8.7	34.3	57	NA	NA	NA	NA	NA	NA	NA	NA
HK.A.SE.4	10.4	29.2	60.5	0	0	8	2.9	9	28.6	53.7	m-p
HK.A.NE.6	12.9	28.9	58.3	0	0.8	0.7	3.1	11	43.3	38.8	mw
HK.A.SE.5	9.9	58.5	31.6	1.5	0.4	1.5	3	6.8	29.1	54.9	mw-w
HK.A.NE.1	12.2	57.6	30.1	NA	NA	NA	NA	NA	NA	NA	NA

Sample	*4 mm*	*2 mm*	*1 mm*	*0.5 mm*	*0.21 mm*	*0.125 mm*	*0.063 mm*	*Comments*
HK.A.SW.2	NA	NA	old bone; charcoal; gray ceram.; limestone; black shiny melted glass-like substance (sand? Resin?)	charcoal; ceram red gray; limestone; qtz sr hs polish and dv	5 % charcoal & red ceram; trace black shiny melted substance, seed; qtz less r	qtz less r dom; 5 % charcoal & red ceram; trace black shiny melted substance, seed	qtz less r dom; 5 % charcoal & red ceram; trace black shiny melted substance, seed	none
HK.A.NW.1	NA	NA	NA	NA	NA	NA	NA	none
HK.A.SE.2	NA	red ceram., sr-sa	ceram. and concretion dom; trace charcoal & flint	20-25 % ceram.; trace charcoal, qtz wr, flint flake	30 % qtz r-sr; 20 % ceram.; trace charcoal, charred chaff, white shell; dark shell; black schist	qtz dom; 30-40 % rock sr-sa; 20-30 % ceram.; charcoal incl. charred chaff; some wr unidentified stone	qtz dom; 40 % rock; 20-30% ceram.; trace charcoal, charred chaff	none
HK.A.NW.4	NA	NA	NA	NA	NA	NA	NA	none
HK.A.SE.3	burnt sediment	burnt sedi	concretion sr dom; 5 % qtz r-sr	20 % qtz r-sr; trace concretion sr	qtz r-wr dom; 30 % concretion sr-a; 2-5 % charcoal; trace flint	qtz sr; trace concretion sr, charcoal	qtz sr dom; trace concretion sr, charcoal	very similar to HKASE2
HK.A.NE.2	NA	NA	NA	NA	NA	NA	NA	Could ash/charcoal content give it its colour?
HK.A.NE.3	NA	NA	NA	NA	NA	NA	NA	similar texture to HKA.NE2 though not as dark
HK.A.SE.6	NA	NA	concretion/ dom ceram; concretion trace	20-30 % concretion sr-sa; 20% qtz wr-sr; 2% charcoal; trace bladed mica, flint, bone	mostly qtz and mica, r bladed; 5 % charcoal, burnt chaff; trace ceram, burnt bone	qtz and mica r and bladed dom; 5% charcoal, burnt chaff; trace ceram, burnt bone	qtz and mica r and bladed dom; 5 % charcoal, charred chaff, charred bone?; ceram.	Pott sherd in attached mortar
HK.A.NE.4	NA	ceram red, gray and black dom, 40 % with gray calcinations; 30% concretions; trace limestone sr ls	ceram. dom; 5 % concretion; 2 % qtz dv, ls, sr; trace charred gray bone & unmodified rocks	20 % ceram. red and gray; 5 % concretion; 2 % charcoal, both bone and org; 1 bone; qtz dv, hs>ls, sr-r	qtz dv hs>ls sr-r & patina a; 10 % ceram; 5 % concretion; 2 % charcoal, charred bones; mica	50 % qtz ls mostly with dv; 20 % ceram.; 10 % charcoal; mica; concretion?	50 % qtz ls mostly with dv; 20 % ceram.; 10 % charcoal; mica; concretion?	none

Sand Description of Mudbricks from Khasekhemwy's Enclosure at Hierakonpolis, Phase 1

Sample	*4 mm*	*2 mm*	*1 mm*	*0.5 mm*	*0.21 mm*	*0.125 mm*	*0.063 mm*	*Comments*
HK.A.NW.5	NA	ceram r and burnt sedi w dom, trace limestone wr, sandstone, blue bone, gray ceram./concretion	ceram sr dom; 20 % concretion; 5 % charcoal; trace wr-sr polished qtz, bone, flint flake, schist	40 % qtz, mostly polished, hs, r; 10 % ceram.; 5 % concretion; 5 % charcoal incl. 2 charred chaff; trace bones	30-40 % qtz polished sr-r; 5 % ceram; 5 % charcoal, charred chaff; trace concretion, brown polished mammal bone poss rodent, flint, mica	40 % qtz polished and patina; 10 % charcoal, charred chaff; trace ceram/concretion; mica	40 % qtz polished and patina; 10 % charcoal, charred chaff; trace ceram/concretion; mica	none
HK.A.SW.1	NA	burnt sedi, ceram, bone all wr	ceram. red, gray dom; 2 % concretion; trace burnt sedi, limestone r sa, charred bone, qtz polished r, gray fine grained stone or ceram: v polished surface breaks with nail	20 % ceram red and gray sa.; 10 % qtz polished and patina starting to have facets sr-r; trace charcoal and burnt bone; some unid. Material, very black with holes, like stone; trace sr limestone; trace black flint; trace bone	10-20 % ceram a & qtz 3/4 patina a-sr, 1/4 polished a; trace bone; mica	qtz a-sr, polished and patina dom; 20 % ceram.; 10 % charcoal, charred chaff; trace limestone; mica	qtz a-sr, polished and patina dom; 20 % ceram.; 10 % charcoal, charred chaff; trace limestone; mica	none
HK.A.NW.2	NA	NA	NA	NA	NA	NA	NA	none
HK.A.SE.4	NA	concretions, ceram sr-r	rocks sr & concretions sr dom	qtz, mostly r-sa; trace charcoal	qtz r with few sr; 2 % sedi grains; trace charcoal; bladed mica	qtz sr-sa dom; trace charcoal; flint	qtz sa-sr-r rod a bladed dom; trace charcoal	none
HK.A.NE.6	NA	concretion, r-wr dom; trace pebble rod shaped wr facets	concretions & qtz sr polished > wr patina dom; 40 % red ceram sr l-hs; 10 % limestone sa hs; trace rock wr- sa polished hs, schist sa hs, other unidentified sedi/grainy rocks	50 % qtz polished wr; 5 % qtz patina with facets; 5 % ceram. sr; 2 % schist trace concretions; limestone r hs; sandstone sr ls; burnt sediment; bladed mica; 2 bones; disc shaped unidentified rocks; 1 rod shaped charred gray bone or worked stone, with lighter lines at edges	30-40 % qtz polished r hs to sr; 10 % chaff; 5 % ceram.s; 5 % charcoal,. charred chaff; trace sr bone; mica	qtz polished less r; ceram; charcoal, charred chaff; mica; concretions?	qtz polished less r; ceram; charcoal, charred chaff; mica; concretions?	none
HK.A.SE.5	concret ion	concretions	concretion dom; trace qtz r	40 % concretion; 5% qtz wr-r mainly, some sr-a; poss trace of red and black ceram.; 1 long hard gray/black rectangular inclusion: bone? Metal? (see data sheet)	30 % qtz r; 2 % ceram.; rest black concretion, some look charred; trace charcoal and bone; mica	qtz sr-r dom; 5 % charcoal; trace concretion, red ceram; mica	qtz sr-r dom; 5 % charcoal; trace concretion, red ceram.; mica	none
HK.A.NE.1	NA	NA	NA	NA	NA	NA	NA	very silty but not visible in colour

Sand Description of Mudbricks from Khasekhemwy's Enclosure at Hierakonpolis, Phase 1 (continued)

Sample	*Sample Type*	*Sample Location*	*Colour*	*Munsell Colour (Wet)*	*Texture/Composition*	*Organic Temper*	*Charcoal*
HK.B.NE.1	brick	NE wall, near centre, int, directly abutting ph.A bricks	very dark gray to very dark grayish brown	10 YR 3/1 - 10 YR 3/2	homog.	10-20 % chaff; big stalks < 0.5 cm long; a lot compared to others; chaff seems to last longer in harder bricks or they put more in	yes, trace
HK.B.NE.2	brick	NE wall left of centre and interior of wall c. 18 courses above odern ground level	dark grayish brown	10 YR 4/2	homog. with mild sedi layers	yes, chaff < 0.8 cm 10-20 %; bh c. 10 %	yes, trace < 0.1 cm
HK.B.NE.3	brick	NE wall c. 15 cm from N corner near modern surface c. 15 courses	dark grayish brown to brown	10 YR 4/2 - 4/3	homog. with dark lump	yes, a lot of bh; chaff c. 5 %	none
HK.B.NE.6	brick	NE wall	brown	10 YR 4/3	heter with sedi layers	yes, v large straw 2.5 cm long; chaff.manure; bh though not as many as others	none
HK.B.NW.1	brick	NW wall	very dark grayish brown to dark brown	10 YR 3/2 - 3/3	homog. with mild sedi layers	yes, chaff v v fine fibers 5-10 % + bh c. 5 %	none
HK.B.NW.2	brick	NW wall	dark grayish brown	10 YR 4/2	homog. with chunks	yes, c. 20 % v fine chaff + bh	yes, trace though v hard to see
HK.B.NW.3	brick	NW wall	dark grayish brown	10 YR 4/2	homog. with mild sedi layers	yes, chaff/straw c. 10 % v fine and small	yes, with one c. 1 cm larger than other bits
HK.B.NW.4	brick	NW wall	very dark grayish brown to dark brown	10 YR 3/2 - 3/3	homog. with mild sedi layer	yes	yes
HK.B.SW.1	brick	SW wall	dark brown	10 YR 3/3	homog. with tiny hard sedi lumps (1887)	yes	yes, some tiny bits floating; homog paste indic good mixing tf charcoal more likely to be destroyed in KHB bricks.
HK.B.SW.2	brick	SW wall	dark brown to very dark brown	7.5 YR 3/2 - 2.5/2	homog.	yes	none

Visual Description of Mudbricks from Khasekhemwy's Enclosure at Hierakonpolis, Phase 2

Sample	*Sample Type*	*Sample Location*	*Colour*	*Munsell Colour (Wet)*	*Texture/Composition*	*Organic Temper*	*Charcoal*
HK.B.SE.5	brick	SE wall centre top of collapsed wall	dark brown to dark grayish brown	10 YR 3/3 - 3/2	homog. with mild sedi layers	yes, quite a lot of org remains, poss manure	yes, a lot charred chaff and charcoal floaing and of diff sizes
HK.B.SE.6	brick	SE wall right of bricked up 'window' feature (from enclosure interior)	dark grayish brown	10 YR 4/2	homog. with some lumps and stains v hard to ID bc well mixe	yes, a lot of bh and some chaff like org, some reddish/orange coloured straw	yes, charred chaff
HK.B.SE.8	brick	SE wall outer section in hole from fallen portion of wall near S corner	dark grayish brown to brown	10 YR 4/2 - 4/3	homog. with two types of mild sedi layers	yes, v finely chopped chaff floating, up to 0.3 cm long	yes, quite a lot of tiny bits charcoal floating and charred chaff (1931)
HK.B.PW.NW.1	brick	perim wall, NW wall	dark grayish brown to brown	10 YR 3/2 - 3/3	homog.	yes, some remains of chaff/org content and a lot of bh and straw impressions	yes
HK.B.PW.SE.1	brick	perim. Wall, SE wall	brown	10 YR 4/3	homog.	yes, some	yes; charred chaff/straw; floating charcoal is prob charred chaff

Visual Description of Mudbricks from Khasekhemwy's Enclosure at Hierakonpolis, Phase 2 (continued)

Grain Size Distribution and Sand Sorting of Mudbricks from Khasekhemwy's Enclosure at Hierakonpolis, Phase 2

Sample	*Clay %*	*Silt %*	*Sand %*	*4 mm %*	*2 mm %*	*1 mm %*	*0.5 mm %*	*0.21 mm %*	*0.125 mm %*	*0.063 mm %*	*Sorting*
HK.B.NE.1	11.2	69.6	19.2	NA	NA	NA	NA	NA	NA	NA	NA
HK.B.NE.2	6.9	44.5	48.6	NA	NA	NA	NA	NA	NA	NA	NA
HK.B.NE.3	15.8	48.9	35.2	NA	NA	NA	NA	NA	NA	NA	NA
HK.B.NE.6	11.2	42.3	46.5	0	0.3	0.7	3.2	12.9	44	34.2	mw
HK.B.NW.1	17.9	26.9	55.4	0	0.7	0.3	0.8	8	50.1	36	w
HK.B.NW.2	10.2	52.1	37.7	NA	NA	NA	NA	NA	NA	NA	NA
HK.B.NW.3	12.1	39.3	48.3	NA	NA	NA	NA	NA	NA	NA	NA
HK.B.NW.4	11.4	51	37.5	0	1.6	1.2	5.8	8.4	36.9	43.5	mw
HK.B.SW.1	16.2	39	44.8	0	0	0.3	1.2	7	44.4	43.8	w
HK.B.SW.2	16.3	47.8	36	0	0	0.7	1.7	2.5	44.4	34.2	w
HK.B.SE.5	13.5	49.3	37.2	0	0.3	0.7	2.1	7	42.2	43.6	w
HK.B.SE.6	11.6	61.8	26.6	2.4	3.1	2.1	3.7	4.7	21.7	59.9	m-p
HK.B.SE.8	12.4	54.4	34.4	0.4	0.5	0.7	3.9	3.2	39.1	52.2	vw
HK.B.PW.NW.1	12.5	46.4	41.1	0	0.6	0.3	0.8	8	50.1	36	w
HK.B.PW.SE.1	13.2	44	42.7	1	1.3	1.2	3.8	11	33.2	45.2	mw

Sample	*4 mm*	*2 mm*	*1mm*	*0.5 mm*	*0.21 mm*	*0.125 mm*	*0.063 mm*	*Comments*
HK.B.NE.1	NA	NA	NA	NA	NA	NA	NA	none
HK.B.NE.2	NA	NA	NA	NA	NA	NA	NA	none
HK.B.NE.3	NA	NA	NA	NA	NA	NA	NA	none
HK.B.NE.6	NA	concretion, ceramic, burnt sed.	ceram dom; 50 % concretions; trace burnt sedi, copper green oxyde	50 % charcoal; 40 % qtz polished and dv hs sr-r dom; 10 % ceramic; trace concretion, sandstone, limestone, other stone, mica	qtz polish few dv hs sa-sr dom; 5 % ceramic; 2-5 % charcoal, charred seeds, burnt sedi; mica	qtz dom; 10 % ceramic; 2-5 % charcoal; mica	NA	none
HK.B.NW.1	NA	NA	NA	NA	NA	NA	NA	none
HK.B.NW.2	NA	NA	NA	NA	NA	NA	NA	none
HK.B.NW.3	NA	NA	NA	NA	NA	NA	NA	v small sample; ceram 4.5 x 3 x 1.1 cm light reddish brown 5YR 6/4 poss from mortar
HK.B.NW.4	NA	concretion dom; trace ceramic, charred wood, burnt sedi	concretion dom; 2-5 % ceramic sr; 2 % qtz patina few with facets r-sr hs; trace stone sr-r, charcoal	qtz patina hs wr-r dom; 5 % concretion; 2 % ceramic; trace charcoal, sandstone r	qtz sr hs-ls dom; 5 % charcoal, concretion, ceram; mica	qtz patina a dom; 10 % charcoal; 2 % ceram; trace concretion, bone; mica	NA	high organic content, difficult identify microartefacts
HK.B.SW.1	NA	NA	concretion a dom; 2 % ceramic; limestone r-sr hs	ceramic dom; 2 % burnt sedi; trace charcoal, qtz sr-r hs polished some dv	qtz sa-r h-ls dom; 5 % ceram red and gray; 2% charcoal; trace concretions, limestone; mica	qtz polish, dv a-sr h-ls; 5 % ceramic; 2 % charcoal; mica	NA	high organic content
HK.B.SW.2	NA	concretions	concretion dom; 5 % burnt sediment; trace ceramic ls, qtz ms r	concretion dom; 2 % burnt sedi; trace qtz polished sr hs	qtz sr-a, ms dom; 5 % concretion; 2 % burnt sediment; trace ceram	qtz polished a ms; trace burnt sedi, mica little compared to others	NA	none
HK.B.SE.5	NA	ceramic, concretion	concretion & ceram dom; 2 % qtz patina few polished hs sr	concretion and ceramic sa-sr dom; trace charcoal, burnt chaff, qtz wr-r hs few patina	qtz sr-r, polished, mostly hs, with few ls dom; 5 % concretion; 2-5 % ceramic; trace charcoal; mica; trace flat bone	qtz a-sr h-ls some polished some factes patina dom; 2 % charcoal; 2 % ceram	NA	(1913) all soils, top left dark, right yellow with charcoal and chaff

Sand Description of Mudbricks from Khasekhemwy's Enclosure at Hierakonpolis, Phase 2

Sample	*4 mm*	*2 mm*	*1mm*	*0.5 mm*	*0.21 mm*	*0.125 mm*	*0.063 mm*	*Comments*
HK.B.SE.6	concretion	concretion dom; trace limestone	concretion dom; trace ceram, burnt sedi	concretion dom; 40 % limestone; trace red ceram or burnt sedi, qtz r-wr hs hard to confirm dv	concretion and qtz polished with some dv r hs dom; trace red and gray ceram; mica	qtz a-r polish dv dom; 2 % concretion/ceram; trace charcoal, limestone; mica	NA	none
HK.B.SE.8	NA	concretion, fine red ceram	fine red ceram dom; trace charcoal, fine gray ceram	qtz sr-r hs some sr-sa ls and ceramic dom; trace charcoal	qtz sr-sa m-ls dom; 20 % ceramic; trace charcoal	qtz sr-r hs some sr-sa ls dom; 20 % ceram; trace charcoal	NA	similar to HK.B.SE6
HK.B.PW.NW.1	NA	cermic dom, trace blue bone, concretion	concretion dom, trace ceram, burnt sedi, qtz dv r with facets	ceram dom; 5 % concretion; 2 % burnt sedi; trace bone, limestone, qtz dv r with facets	qtz polished sa-r dom; 5 % ceram; 2 % charcoal, concretion; trace tan colour hard stone laminated/stack-like inclusion (see data sheet); mica	qtz polished & dv dom; 20 % ceram; 2 % charcoal, charred chaff; mica	NA	none
HK.B.PW.SE.1	concretion	concretion dom; trace burnt sedi, ceram, flat sandstone, qtz dv ls sa	ceram, concretion, qtz sa-sr maybe trace of dv dom; 2% limestone; trace of burnt sedi	qtz a-r hs polished starting dv mostly; 5 % ceram; trace charcoal, concretions?	qtz dv sa-sr ms & transluscent polished a-sr hs dom; trace burnt sedi, ceram; mica	qtz a-r allt s starting dv some polished; 5 % ceram; 2 % charcoal	**0.063 mm**	none

Sand Description of Mudbricks from Khasekhemwy's Enclosure at Hierakonpolis, Phase 2 (continued)