The Burial Mounds of Central Tibet

Layout – Construction – Material

Based on data from the fieldwork in 2014

Hubert Feiglstorfer

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http://www.oeaw.ac.at/tibetantumulustradition (hereafter TTT)

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Structural Aspects of Central Tibetan Burial Mounds

1. Introductory remarks

The following is a first description of the architectural data collected by the author during the fieldwork in Central Tibet in May, June 2014. This field research was carried out in collaboration with Guntram Hazod (ISA) and Martin Gamon (from LBI ArchPro) in the framework of the ASF financed project “The Burial Mounds of Central Tibet” (P 25066-G19).

The architectural survey was conducted with common equipment suitable for a small research team, the altitude and a timely progress of the work, as described in Feiglstorfer 2008. The “structure-from-motion” (SfM) photography was an additional tool, which made it possible to generate three dimensional (3D) models of the sites visited. The in situ surveys focused on the layout of the mounds and on details of construction of the objects and their architectural relation to each other, also regarding the ritual architecture of the immediate environment. Today our architectural study of dozens of burial mounds in Central Tibet enables us not only to talk about structural features but also to draw the contours of typologies and to make sound statements for future comparative research in terms of architectural relationships with other burial mound cultures within the Tibetan Highlands (especially the grave fields in the Tuyuhun area of eastern Tibet; Tong Tao 2008) and the Central Asian regions. In fact, at the current state of research we see several typical architectural aspects with regard to ground plan, shape, size, the orientation, construction methods or the use of building material.

2. The ruins of the mounds

The mounds we studied are in various states of dereliction, which were either of anthropogenic or natural reason. The different states of disrepair shed light on structural patterns, which would otherwise be hidden beneath the surface. The latter situation concerns only a few mounds, which apparently have not been touched, whereas most are historically opened mounds. Some tombs have been completely gutted, with just parts of the flanks remaining. Most of the stones (either crushed or round depending on the mound’s proximity to a riverbed) have been removed by the locals, evidently for building purposes (example: Site 0142). In some cases the stone walls were only partially removed and the adjoining wall layers have been opened and exposed. At one site, some mounds or even group of mounds have fallen victim to government construction projects. Some of this major damage has opened the mounds up to the central core and exposed the interior structure.

Weathering is another factor of deconstruction, primarily affecting the surface by wind and water erosion, in some cases also destroying whole sections of a mound by water running through the grave field situated in the alluvial fan. The surface erosion takes different forms, determined by the mineral composition and the grain-size distribution of the surface material. In some cases effects of erosion left a stepped design (example 0141), in others it simply reduced the volume of the mound. In cases, where the earth shell protecting the stone walls has been eroded, the walls, which were built without mortar, have fallen apart and the stones have been scattered over the surrounding terrain.

3. Building material

The basic raw materials for the construction of mounds were earth and stone, which were pre-cessed by different construction methods. Wood in the form of sticks and branches was used for stabilising purposes but not for primary construction. No fibres were found within the earth of the mounds, either in the rammed earth or in the adobe bricks. Sticks and branches are in most cases missing, either due to weathering or due to removal by locals. In any case, their former use can be assumed by the existence of remaining holes in the tomb walls. The material seems to have been taken from the immediate vicinity. Geological and mineralogical examinations of the local raw material related to its origin and to its use for particular techniques are planned as a further step in our research project.

Related calculations for the effort in making a large (elite) burial mound have been made. These data will be more precise after a further examination of the raw material. Such calculations may provide evidence of the number of workers and the time needed for the preparation of a grave.

Our material analysis has so far included the stone lions of Chad kha, which were originally situated in
front of an elite burial mound of 0105 (in Mal gro; see Hazod 2015). Most likely these were made from rocks lying next to the mound in question, which have been identified as probably being basalt.

4. Structural aspects

A closer look at the construction features shows that there were different ways of fitting a mound into its topographical environment and also different internal structures – in terms of building material, their individual sizes or their composition. Each burial mound seems to follow its own internal construction ‘anatomy’. Individual building decisions may be related to a mound’s total size, the topographical situation, the material available on site, and certainly also the principal’s capability regarding the expenditure on labour.

The mounds examined do not have one single construction structure but a composition of several components, starting with the grave chamber as the inner core followed by an alternation of massive building elements made of stone or rammed earth and backfilling with loose or compressed earth in between. The finding of a rammed earth platform at ground level in Mound-1 (M-1) of site 0141 points to the existence of a foundation plate made of rammed earth layers. M-4 of the grave field 0002 shows the alternation of massive stone walls and horizontal and vertical earth infill.

Reconstructing the building phases, the inner core must have been the starting point of a grave-mound construction and the following steps towards the outer shells seem to follow a structural logic. From inside to the outside was the ideal method, which made it possible to concentrate on the core part and the preparation of the chamber for the deceased at the geometrical centre.

Depending on the size of tomb, a vertical or horizontal shaft was kept for later access to the inner chamber. M-1 of 0002 or also M-1 of 0004 (both in Yar lung) have remaining niches, which may relate to the existence of a vertically organised access shaft with the entrance from the top of the mound. It also appears that the access shafts did not end above the chambers but in front of them. This points to the existence of an antechamber connected to the actual grave chamber.

5. The inner structure

Several tombs in the field 0131 (in Lo Valley, Stag rtse County) had been demolished by a bulldozer, so that the inner structure of one mound had been torn apart in such a way that the grave chamber, in particular the walls and the roof, remained accessible for examination. The tomb construction here reveals the importance of a solid and secure encasing of the body’s remains. No evidence of burial objects was found.

The outer walls were made of quarry stones, all cut to size by hand to make two walls 50 cm high by 50 cm wide and 87 cm apart. The rear was closed by two rocks and the front of the chamber was open. The floor was earth and the roof was covered by a 150/100/40 cm rock (L/W/H). This chamber is rather small, with a rock as roof, which structurally represented the simplest method. Laterally these stone walls were embedded in compressed earth, similar to rammed earth but not in regular layers as we know it from rammed walls. The graves found in some fields were apparently not rammed.

6. The individual sites

6.1 Sites 0141 and 0142 (pp. 8–25):

The stone plates along the top of M-1 at field 0141 indicate the location of the stone walls below. At ca. 140 cm, the wall is rather thick (section B-B). Two stone walls were erected next to each other ca. 2 m apart. The geometry of the side walls defines the orientation of the inner structure of the mound, with ca. 80° obtuse angles of the trapezoid, a ground plan geometry that we often find for trapezoid mounds with an average of ca. 83°±4° beside two examples with 71° (field 0171) and 73° (field 0002). The top of the mound is eroded. It cannot be excluded that earth was originally used to raise the mound into a spherical form, as hypothetically reconstructed (see M-2; sections A-A and B-B). The stepped signs of erosion are clearly visible at this M-1 (section A-A). Stone walls at M-1 and M-2 at field 0141 appear to be structurally connected with the rammed earth wall. The section through one wall construction at M-2 shows a ca. 50-cm-thick stone wall, supported on both sides by a rammed earth wall. Since the stone walls were erected without mortar and to a height of 1.6 m and a thickness of only 50 cm it was necessary to build a kind of a ‘lost formwork’,
which was possibly originally connected with the stone wall. Section B-B shows the use of stone walls as breast walls to hold the load of the adjoining hill. Photos from stone walls at field 0142 (Cha-2) show round shaped walls, which seems to be rather rare.

The earth was rammed in layers ca. 10 cm high separated by rows of stone plates, which we also know from wall constructions of the monastery ruins of old Chad kha. Earth walls, which were rammed in 10 cm layers, represent well-known types of foundation throughout the Himalayas. As to the rammed walls they may either be rammed in higher sections, as in the case of the fortification wall in Chad kha (see photo), or like the towers at the foot of Bya ra mdo (see plans and picture). Walls 140 cm wide, as at M-1 of field 0141 (Cha-1), are rather big but not uncommon, as can be seen in the example of the wall widths of up to 110 cm at the Bya ra mdo towers, whose walls were erected on stone foundations. Such stone foundations again were not necessary for the earth walls at M-1 of Cha-1, since they were enclosed and thus protected against precipitation. One striking similarity between these two rammed constructions is that the corners were not joined but remained open, which structurally is of no relevance for the mound but for the free-standing towers this produced gaps along the corners several centimetres wide in some places. Structurally such a construction may be described as ‘slabs’ that are ‘leant’ but not joined together – on the whole a rather unstable form of construction.

At some sites (example 0142: ground plans at Cha-2) the stone walls form a grid laid above the actual grave chamber for structural protection. A difference is evident in the thickness of the walls in the centre and those at the front of the mound (possibly for structural reasons).

6.2 Site 0367 (Yab, Stod lung County) (pp. 26–28)

These mounds are mostly circular and rather low (see sections). The biggest mound is ca. 15 m in diameter. A circle of loose stones lay across this field marking the individual mounds.

6.3 Site 0032 (Mu ra, in ’Phyong rgyas) (pp. 29–31)

The amount of earth used in the mound for this grave of the emperor Khri Srong lde btsan (no. XI of 0032) was roughly calculated; a re-calculation of the first field note results in the estimate that ca. 200 people must have worked for ca. two years for the duration of the construction.

The two stone lions related to this tomb are located close to the northern corners of the mound. They face towards the tomb, following the diagonals of the mound and their orientation was calculated with GPS and is shown in the overview of this site.

In Mu ra the famous tomb stele on a stone tortoise (situated next to the grave of the emperor Khri Lde srong btsan; 0032, grave no. XIV) is surrounded by a modern temple-like construction. The graphic shows the stele’s integration into the temple’s core and the position of the tortoise about 2.5 m below ground. The reason for the raising of the level of the surrounding terrain was evidently erosion over centuries.

6.4 Site 0171 (Gnyan, Dmar district of Stod lung County) (pp. 32–33)

On top of M-1 there is a modern ‘brog sa (shepherds’ camp site) constructed as a rectangular depression, with the sides lined with a row of stones. M-2 in the same burial mound field has a trapezoid stone formation on its flat surface, similar to the stone marking of cist tombs, but its identification as grave remains uncertain.

6.5 Site 0024 (Bya sa’i ri, ’On valley, Sne gdong County) (pp. 34–35)

This “bird-shaped” field 0024 consists of a central mound (M-1) and seven lateral grave mounds (three plus four) plus ten sacrificial stone pits arranged in a line at the rear of M-1. See the photographic documentation at TTT: field no. 0024.

6.6 Site 0002 (close to Rtse thang, Sne gdong County) (pp. 36–47)

Stone walls are of different types – without mortar between the stones as at M-4 of 0002 (see section) or in a mortar bed, which is a rather thick continuous line, and finally those where the stones were not laid but filled irregularly. The last two types are found in one mound of 0004 (behind Khra ‘brug; see ground
plan and photos). There are no stone walls with well-dressed stones and smaller stones as infill in the gaps as we may find at existing structures in Lhasa (see photo).

Mound 1 has a niche, which may have been a former vertical entrance or antechamber. The wall is again a composition of rammed earth adjoined by a today missing stone wall towards the interior. At Mound 2 the rammed earth wall construction becomes evident and a reconstruction of the missing lateral parts of the mound may show its former shape. Due to missing walls at Mound 3 parts of the 3 x 3 stone grid within the mound become visible. This grid was constructed vertically in several sections: the first rows of stones are ca. 77-88 cm high and were covered by rammed earth on which the following rows of stones were set but partially shifted to the position of the walls below, most probably for structural reasons.

6.7 Site 0043 (Lcags ri, Grva nang) (pp. 48–50)

This mound shows remains of later, primarily stone superstructures on top. Their width varies from 60 cm, 73 cm, 95 cm to 100 cm, also including bivalve constructions. Uphill, the remains of a ramp connecting the mound with the hill behind it are visible.

The process of building a mound can be reconstructed from the surface survey of Mound 3. This is shown axonometrically with 3D models in the chronological steps that it is suggested were followed after the hole had been dug for the tomb and the grave chamber was constructed:
1. Levelling the earth for erecting the first level of a grid of walls.
2. Erecting the first level of a wall grid (model on top and next page).
3. Filling up the space between the walls, covering the walls and levelling the ground again.
4. Erecting the second level of a wall grid but slightly shifted (see all three models).
5. Filling in the space between the walls, covering the walls and shaping the mound with earth.

6.8 Site 0172 (Sgang skyid, Dmar district, Stod lung County) (pp. 51–60)

Similar to site 0043, the remains of a ramp connecting the mound to the hill behind it are visible. The mound is ca. 4.7 m high at the front and 3.3 m at the back. The upper part of the ramp may have been steps, as indicated by the steepness of its remains. At this mound, and due to the absence of the lateral stone walls, the filling of the trapezoidal and later shaping of the mound into a spherical form becomes evident (see photo). Mounds M-2 and M-4 are actually round pits made of stones, which are laid cylindrically into the ground to a depth of ca. 4 m. Examples of shafts are shown as 3D models.

6.9 Site 0105 (Bya ra mdo, Mal gro County) (pp. 61–69)

Along the west side of mound M-1 the stone framing of a possible former pedestal for one of the two guardian lions is visible (see Hazod 2015). Along the east side of the mound the pedestal may have been eroded, because here the ground is more even and slightly sloping.

On top of M-1 two sides of a rectangular stone foundation are visible, raised just a few centimetres above the top of the mound. The orientation of these walls does not correlate with that of the mound as a whole.

The original shape of mound M-2 is not clear – possibly circular, but also square cannot be excluded. On the west side a buttressing wall made of large, thin stone slabs with earth mortar in between adjoining a rammed earth wall is visible (see section). Along the whole south side of this mound there are the remains of steps topped with stone slabs.

Mound M-4 is located on top of a steep hill with a path below. A buttressing wall was erected with two rows of stones. A section through this hill shows the technique of buttressing a hill to protect a mound on top of it.

6.10 Site 0004 (behind Khra ’brug monastery, Sne gdong County) (pp. 71–73)

A partially opened mound shows two different types of stone wall, one with a row of regularly laid stones with continuous lines of earth mortar beds, whereas the other is not continuous. This fact suggests the position of a vertical entrance hole which was later filled with stones to close it permanently.
Bibliography


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Mound I and Mound II. Overview.
Bottom: 3D model with ‘structure-from-motion’ (Agi Soft), Martin Gamon.
Mound I. Ground plan.

Key:
1 Top of the mound: Remains of a trapezoid stone wall.
2 Reconstruction of the position of a former stone wall.
3 Foot of burial mound.
4 Looted area and possible position of the grave chamber.
5 Hypothetical reconstruction of the earlier shape of the mound.

Geometrical data

Site 0141 (Cha I, Stag rtse)
Mound I. Section A–A, Section B–B (in red).

Key for Section A–A:
1 Stone wall.
2 Shape of eroded earthen mound.
3 Hypothetical earlier shape of the mound.
4 Terrain.
5 Looted area and possible position of the grave chamber.
6 Hypothetical position of a second stone wall (see nr. 8).
7 Shape of inside the mound: Plane without steps of erosion.

Key for Section B–B:
8 Stone wall.
9 Second outer stone wall.
10 Shape of eroded earthen mound.
11 Terrain of Section B–B.

Detail of section B–B: Stone wall.
In Section A–A marked with ‘8’.
Mound I and II: 3D models with 'structure-from-motion' (Agi Soft), Martin Gamon.
Top: Mound 1 in front showing stepped eroded embankment.
Middle: Mound 2 with north and east sides showing stepped eroded embankment.
Bottom: Mound 2 with south and west front showing rammed earth walls.

Detail of section A–A: Stepped slope.
In Section A–A marked with ‘2’.

Site 0141 (Cha I, Stag rtse)
Mound I. Overview from the south.

Mound I. Top of the mound.

Mound II. Stones to the east of the mound, probably remains from the stone walls of the mound.

Site 0141 (Cha I, Stag rtse)
Mound II. Ground plan.

**Key:**
1. Escarpment by demolishment or erosion, bordering the plateau on top of the mound.
2. Escarpment, towards the south much stronger than at ‘1’.
3. Rammed earth wall, straight lined in the north and west; acting like a lost formwork for the adjoining stone wall.
4. Rammed earth wall, in the south following a wavy course, probably due to demolishment.
5. Reconstructed course of the rammed earth wall according to the course of ‘3’ and the position of ‘4’.
6. Outer shape of the base of the mound in the east and south; contrary to ‘3’.
7. Hypothetical former shapes of the earthen mound.

Mound II. Geometrical data.

Site 0141 (Cha I, Stag rtse)
Key for Sections A–A and B–B:
1 View of the rammed earth wall.
2 Section through the rammed earth wall; width app. 115 cm.
3 Reconstruction of a stone wall; according to an existing and exposed stone wall on the south side.
   The stones along the rammed earth walls on the north and west side are missing, probably caused by theft.
4 Cover of the sub-construction with earth; according to the south and east side.
   Hypothetical former shapes of the earthen mound.
5 Terrain.
6 Hypothetical reconstruction of the outer shape of the top of the mound.
Site 0141 (Cha I, Stag rtse)
Mound II. East side.

Mound II. North-eastern corner.

Mound II. North-western corner.

Site 0141 (Cha I, Stag rtse)
Mound II. North-western corner.

Mound II. Rammed earth and stone wall along the south section.

Mound II. Hole along the south side; depth about 220 cm; no cracks within this hole which shows remains of a rammed earth foundation.

Site 0141 (Cha I, Stag rtse)
Site 0141 (Cha I, Stag rtse)

Mound II. East side.

Mound II. North-eastern corner.

Mound II. North-western corner.
Mound I and Mound II. Overview.
Key for ground plan:
1 Moat; former stone foundation.
2 Burial mound.

Site 0142 (Cha II, Stag rtse)
Site 0142 (Cha II, Stag rtse)

Mound I. Present state with missing stone wall.

Mound I. Reconstruction of the missing stone wall.
Key for ground plan:
1 Moat; former stone foundation.
2 Burial mound.

Site 0142 (Cha II, Stag rtse)
Mound II. Present state with missing stone wall.

Mound II. Reconstruction of the missing stone wall.

Site 0142 (Cha II, Stag rtse)
Round shaped stone wall of a mound.

Mound I. South-western corner.
Mound II. View from the west.

Mound II. View from the east.

Mound II. View of the position of the former stone wall.
Circular burial mound.

Remains of circular stone foundations.  

Example IV – Remains of circular stone foundations.

Site 0367 (Yab, Stod lung)
Site 0367 (Yab, Stod lung)

EXAMPLE I
Ground plan.

Section A-A.

EXAMPLE II
Ground plan.

Section A-A.

Site 0367 (Yab, Stod lung)
Site 0367 (Yab, Stod lung)

EXAMPLE III

Ground plan.

Section A-A.

EXAMPLE IV

Ground plan.

Section A-A.

Site 0367 (Yab, Stod lung)
Hypothetical calculation of man power in relation to the time span of erecting the burial mound (120x120x26m):

Result of calculation: 200 persons working for about 2 years.

Calculation method:
- 1 person manipulating 40 kg of earth (digging, putting in basket, emptying)...takes app. 5 minutes

- For 2000 kg (= 1 m$^3$ of earth): i.e. 5 min / 40 kg = 0.125 min per kg or 250 min per 2000 kg.

- This equals 4 hours for 2 tons for 1 person or 2.5 min in the case that 100 persons work together.

- The emperor’s tomb has a volume of app. 274,400 m$^3$. This equals 748,800,000 kg or 748,800 tons.

- If for 100 workers the manipulation of 2 tons takes 2.5 min (= 1.25 min for 1 ton), it takes 936,000 min for 748,800 tons.

- Calculating 1 year with 525,600 min than 936,000 min equal app. 1.7 years (when working 24 hours every day).

- When calculating with 10 working hours per day, the factor 2.4 has to be applied and instead of 1.7 years it would take 4 years for 100 workers or 2 years for 200 workers.

- This calculation does not include any architectural construction like corbelled roofs or stone walls.

Site 0032 (Mu ra, ‘Phyong po)
Lhakhang built around the stone stele.

Entrance to the lhakhang.

Stone stele based on the original terrain, about 240 cm below the today existing terrain outside the lhakhang.

Site 0032 (Mu ra, ’Phyong po)
Site 0032 (Mu ra, 'Phyong po)

Key for section A–A:
1 Stele.
2 Turtle.
3 Lhakhang walls (recent construction).
4 Surrounding terrain.
5 Terrain below turtle.
Mound I and Mound II.

Mound I. ‘brog sa (a nomad’s place or camp).

Mound II. Trapezoid stone formation.

Site 0171 (Gnyan, Stod lung)
Tibetan Tumulus Tradition

Mound I. Section A-A of the 'brog sa.

Mound I. Ground plan of the 'brog sa.
Located on top of the mound.

Key for ground plan and section of the 'brog sa:
1 Entrance.
2 Hip of stone.
3 Floor of 'brog sa (a nomad’s place or camp).
4 Row of ashlar.
5 Rammed earth flush-mounted with ashlar.
6 Surface drain.
7 Burial mound.

Mound I. Section of the whole mound.

Site 0171 (Gnyan, Stod lung)
Mound I. Overview.

1 Top of stone walls = top of the burial mound.
2 Foot of the mound.

Site 0024 (Bya sa’i ri, Sne gdong)
Mound I. View from the east side.

Pits to the west of Mound I.

Pits to the west of Mound I.

Site 0024 (Bya sa’i ri, Sne gdong)
Mounds I to IV.

Mound IV. View from the south.

Site 0002 (Yar-2, Sne gdong)
Mound I. Ground plan.

Key for section A-A:
1 Rammed earth wall.
2 Former stone wall; most of the stones are missing, probably due to the:
3 Niche due to former vertical access from the top of the mound;
   probably linked to an ante chamber or to the grave chamber itself.
4 Hypothetical position of the area of the grave chamber.
5 Foot of the mound.
6 Top of the mound.

Mound I. Section A-A.

Mound I. Geometrical data.

Site 0002 (Yar-2, Sne gdong)
Mound I. Sandwich-pattern of a rammed earth wall.

Mound I. Niche in the south-east wall.

Mound I. Missing stone wall in the north-east of the mound.

Site 0002 (Yar-2, Sne gdong)
South-east wall with protrusions framing the internal niche.

Niche in the south-east wall.

Detail of rammed earth wall framing a former stone wall.

Site 0002 (Yar-2, Sne gdong)
Mound II.

*Key for ground plan:*
1 Scarp: earth compressed.
2 Reconstructed lateral border of the mound, demolished section.
3 Top of the mound.
4 Foot of the mound.
5 Small compression (probably due to looting).

*Key for section A-A:*
1 Top of the mound (no remains of stone walls).
2 Demolished section.
3 Eroded or demolished section.
Mound I. View from the east side.

Small mounds to the west of Mound I.

Mound I. Detail of rammed earth wall.
Mound III. Overview and geometrical data.

Key for the numbers
1...Burial mound of rammed earth.
2...Reconstructed part with measurements and photographs.
   On satellite images parts of the north-west front of this mound were still existent.
3...Reconstructed stone walls after the remains of the stone walls.
   Width of the walls: ca. 70 cm.
4...Stone walls, completely missing, hypothetically reconstructed.
5...Scarp (man made, no erosion).
6...Hypothetical front of a former stone wall.
7...Modern path (not existent on satellite image of 2011); after the mound’s destruction.
8...Area of the grave chamber (hypothetical).
9...Ground level.
Site 0002 (Yar-2, Sne gdong)
Mound III. Reconstruction of the process of constructing the part of a mound above the chamber.
Model on top showing the stone grids, model below the covering with an earth mound and model on opposite page all steps in one.
1. Digging the hole.
2. Erecting the grave chamber (not part of this 3D-model) and filling up the surrounding with earth.
3. Levelling the earth at a certain level for erecting the first level of a grid of walls.
4. Erecting the first level of a wall grid.
5. Filling up the interspace between the walls, covering the walls and again levelling.
6. Erecting the second level of a wall grid but slightly shifted.
7. Filling up the interspace between the walls, covering the walls and shaping the mound with earth.

Site 0002 (Yar-2, Sue gdong)
Mound III. Reconstruction of the process of constructing a mound.

Mound III. Sections of the wall construction.
Site 0002 (Yar-2, Sne gdong)

Mound III. View of the north-west section.

Mound III. View into the mound showing remains of a stone wall foundation made of loosely laid slate plates.

Mound III. Top of the mound: missing stone walls.
Mound III. Detail of the north-western corner.

Mound III. Top of the mound showing missing stone walls.

Mound III. Top of the mound showing missing stone walls.

Site 0002 (Yar-2, Sne gdong)
Mound I. Ground plan. View of the norther corner of Mound I.

**Key to ground plan:**
A to D Wall remains of four building structures.
1 Plateau = top of the burial mound.
2 Two chambers: Width of stone walls app. 50 to 65 cm.
3 Bivalve wall: Outer stone wall (ca. 70 cm) - central filling with earth (ca. 260 cm) - inner stone wall (ca. 65 cm).
4 Stone wall (ca. 60 cm).
5 Stone wall (ca. 95 cm).
6 Stone wall (ca. 73 cm).
7 Stone wall (ca. 100 cm).
8 Ramp connecting the mound with a foot path in the NE.
9 Foot paths.
10 Foot of the mound.

Mound I. Geometrical data.

Site 0043 (Leags ri, Grva nang)
MOUND I. Ground plan of the structural remains in the southern corner on top of the plateau.

Mound I. View of the norther corner of Mound I.

Mound I. Building structure on top of the mound located in the southern corner.

Site 0043 (Lcags ri, Grva nang)
Mound I. North section.
Stone wall along the top of the mound.

Mound I. East section.
Stone wall along the top of the mound.

Mound I. Plateau on top of the mound stone wall (see nr. 5) in the ground plan.

Site 0043 (Lcags ri, Grva nang)
Mounds I to IV. Overview.

Mound I. North western corner. Mound I. View of the western section of the mound.
Site 172. Overview from the west.
3D model with ‘structure-from-motion’ (Agi Soft), Martin Gamon.

Site 172. Overview from the east.
3D model with ‘structure-from-motion’ (Agi Soft), Martin Gamon.

Site 0172 (Sgang skyid, Stod lung)
Mound II. Ground plan.

Key for ground plan:
1 Plateau = top of the burial mound.
2 Excavation pit on top of the plateau.
3 Border of the pit (vertical, not sloping).
4 Slope; in earlier time possibly a staircase.
5 Ramp connecting to the rising slope.

Mound II. Geometrical data.

Site 0172 (Sgang skyid, Stod lung)
Site 172. Mound II. View from the west.  
3D model with ‘structure-from-motion’ (Agi Soft), Martin Gamon.

Key for ground plan:
1. Plateau = top of the burial mound.
2. Excavation pit on top of the plateau.
3. Border of the pit (vertical, not sloping).
4. Slope; in earlier time possibly a staircase.
5. Ramp connecting to the rising slope.
Mound II. South eastern corner.

Mound II. North eastern corner.

Mound II. Detail of north eastern corner showing layers of ramming the earth.

Site 0172 (Sgang skyid, Stod lung)
Mound III.

Key to ground plan.
1 Excavated pit.
2 Top of the mound.
3 Burial mound.

Mound IV.

Key to ground plan.
1 Excavated pit.
2 Top of the mound.
3 Burial mound.

Site 0172 (Sgang skyid, Stod lung)
Mound III.
3D model with ‘structure-from-motion’ (Agi Soft), Hubert Feiglstorfer.

Mound IV.
3D model with ‘structure-from-motion’ (Agi Soft), Hubert Feiglstorfer.
Mound IV. Section.
3D model with ‘structure-from-motion’ (Agi Soft), by Hubert Feiglstorfer.

Site 0172 (Sgang skyid, Stod lung)
Site 0172 (Sgang skyid, Stod lung)
Site 0172 (Sgang skyid, Stod lung)
Mounds I to III.

Mound I. Geometrical data.

Mound II. Geometrical data.

Site 0105 (Bya ra mdo, Mal gro)
Key for ground plan of Mound I:
1 Remains of the upper surface of a stone wall; with a few centimeters surmounting the surrounding level of the plateau of the mound; not following a trapezoidal geometry.
2 Reconstruction of a trapezoid as the outer shape of the mound.
3 Disposal of stones in a half-elliptic shape: Hypothesis to have been the basis of one of the protecting lions.
4 Quarry stone wall; recorded at the south side of the mound.

Key for ground plan of Mound II:
4 Remains of the upper surface of a stone wall; with a few centimeters surmounting the surrounding level of the plateau of the mound.
5 The outer shape of the mound gives more evidence to follow a circle than a square.
6 Hypothetical internal geometric order following a square with the orientation following the outline of ‘4’ and of still existing steps (see section A–A).
Tibetan Tumulus Tradition

Site 0105 (Bya ra mdo, Mal gro)

Mound I. View from the mound into the valley.

Mound I. East side. Possible remains of a pedestal for a stone lion.

Mound I. West side. Possible position of a stone lion.
Mound I. Composite construction of slabs and rammed earth.

Mound I. Slabs on top of the mound.

Mound II. View onto the stone steps.

Site 0105 (Bya ra mdo, Mal gro)
Mound II. Section A–A.

Key for Section A–A:
1. Steps covered with slabs; run measures in average about 35 cm; recorded at the east side of the mound.
2. Earthen filling.
3. Rammed earth wall; recorded at the south side of the mound.
4. Quarry stone wall; recorded at the south side of the mound.

Mound II. Detail of stepped profile.

Mound II. Detail of the foundation.

Site 0105 (Bya ra mdo, Mal gro)
Mound II. Foundation as a composite construction of slabs and rammed earth.

Mound II. Edge of the top of the mound framed with slabs.

Mound II. View from the top of the mound onto the top of the stone foundation-wall.
Site 0105 (Bya ra mdo, Mal gro)

Mound III. Ground plan of the slope-orientated foundation.

Mound III. Section A-A.

Site 0105 (Bya ra mdo, Mal gro)
Mound III. With a view into the valley.

Mound III. Top edge of the mound.

Mound III. Stone walls as foundation.

Site 0105 (Bya ra mdo, Mal gro)
Mound III. Foundation as a composite construction of slabs and rammed earth.

Mound III. Rammed earth walls with slab inlays.

Site 0105 (Bya ra mdo, Mal gro)
View onto the grave chamber.

Grave chamber.

Grave chamber.
Two types of wall constructions (Mural types I and II).

Detail of picture left with mural type I.

Partially opening of a mound.

3D model with ‘structure-from-motion’ (Agi Soft), Hubert Feiglstorfer.

Site 0004 (Yar-4, Sne gdong)
Two different wall constructions beside each other.
3D model with ‘structure-from-motion’ (Agi Soft), Hubert Feiglstorfer.

Ground plan of a open section of a mound.

Key for ground plan:
1 Zone of demolition of one of the mounds.
2-I Mural type I.
2-II Mural type II.
3 Top of the burial mound.
4 Boundary of the demolition zone.
5 Anterior boundary of the burial mound.
 Possibly a later infill in the place of a former vertical access.
3D model with ‘structure-from-motion’ (Agi Soft), Hubert Feiglstorfer.

Sections A-A. Similar to section C-C.

Site 0004 (Yar-4, Sne gdong)
Fortress towers. Groundplan and section A-A.

Fortress. South-west corner.

Chad kha Cakun Bapsa tower
Fortress. West facade.

Fortress. North facade.

Fortress. South-east corner.

Chad kha Cakun Bapsa tower
Site 105. Rocks on top of the plateau at the level of Mound I and II are the possible raw material used to for the lions at Chad kha new monastery. The material quality shows strong similarities to the stone used for the lions.

Site 104. New monastery entrance with guarding stone lions.

Site 104. New monastery. Right lion.
Chad kha monastery. Downhill in white: new monastery. Uphill and unplastered: ruins of the old monastery.

Enclosure wall. Rammed earth construction.

Chad kha monastery ruins
Adobe bricks with flat stone pieces between the brick layers. Foundation made of a traditional regular 3-shell stone foundation.

The 3-shell adobe construction follows the stone construction below with two outer and visible surface layers and smaller pieces as filling elements.

Adobe brick wall with stone pieces between the layers as shown in the example before but not as a 3-shell wall.

Chad kha monastery ruins
Adobe wall made of runners and headers.

Open wall section in the left middle of the picture shows flat stones laid in thick earth mortar.

Adobe brick wall on a 3-shell stone foundation.

Chad kha monastery ruins
3-shell stone wall with irregularly laid outer visible shells.

1-shell stone wall with flat and regularly laid stones.

Chad kha monastery ruins
1-shell stone walls: Wall on top showing more regularity than the wall in the center and at the bottom.

1-shell stone walls: Wall section on top showing less regularity than the wall in the section below.

1-shell stone walls.
Shide Lhakhang. West facade.

Traditional 3-shell wall structure.

Vertically changing layers between bigger and smaller stones. Theses layers remain consistant through the width of the wall.
Changing structure from regular stone construction to window framing structure which is covered with a black coating.

Reduction of the wall thickness for the attics.

The penbey fries is woked into the wall.