



ASTRONOMICAL ORIENTATIONS OF DRAGON HOUSES (LAKA PALLI, KAPSALA, OCHE) AND ARMENA GATE (EUBOEA, GREECE)

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ABSTRACT

The preliminary investigation of the astronomical orientation of monuments at Styra, southern Euboea, includes the triple so called 'dragon house' complex at Laka Palli, one dragon house at Kapsala and one on the summit of Mount Oche, and a monumental gate in the megalithic fortification wall at Armena. Recent luminescence testing dates these remains to approximately the Classical period with apparent re-use in Roman and later times. Thus far no definite astronomical orientation has been determined in the layout of the structures and no celestial stone markers or similar features have been found associated with the dragon houses, however, the relationship of significant stars, constellations and solar stands was well known in antiquity, and the limited results presented here suggests the possibility for further investigation. This study, which considered possible orientations related to sun rise and sun set for the summer and winter solstice, as well as, alignments towards equinoxes and major bright stars and constellations, did observe a general preference for a southern orientation at most of the sites and a possible feature for time observations in the dragon house complex at Laka Palli.

KEYWORDS: Dragon houses, Euboea, Armena, astronomical, orientation, Kapsala, Laka Palli, stars, constellation

INTRODUCTION

Southern Euboea is home to several ancient rectangular structures of unknown function, called dragon houses, built of large cut blocks with virtually intact walls. The preserved stone roofs provide evidence for a false arch construction in which the outer and lower courses of stone serve as a counterweight. Similar corbelled roof construction in earlier times is known in Tiryns and Mycenae as well as in Cyclades, Thrace and southern Russia (Johnson, 1925). The buildings take

their name not from dragons as we understand them today, but from mythical creatures with supernatural powers that were able to achieve such craftsmanship. Most of the dragon houses are located on the region of Styra, but the most famous example is on the peak of Mount Oche, above Karystos (fig. 1). Similar contemporary buildings are found in Karia (Asia Minor) and one is known on Mt. Hymettos in Attica (Carpenter and Boyd, 1977).



Figure 1. Map of Southern Euboea, showing the dragon houses and Armena Gate: D-LP: Laka Palli, D-KA: Kapsala, D-OH: Oche AG: Armena Gate

Many interpretations have been offered over the years about the function of the dragon houses. Suggestions have included buildings of (wealthy) farmers, houses and storage rooms for quarry workers, military posts, or shrines and temples (Carpenter and Boyd, 1977). The dragon house of Mt. Oche has been connected to the worship of Hera and Zeus (Ulrichs, 1842; Welcker, 1850; Bursian, 1855; Baumeister, 1864; Moutsopoulos, 1982).

Bursian (1855) and Welcker (1850) argue that the Laka Palli triple complex were temples dedicated to either of the following triadic deities: Demeter, Persephone (Kore), and Kalymnos, or Apollo, Artemis and Leto, or Zeus (Dias), Hera and Hevi. Another interpretation is that those close to ancient quarries were dedicated to Hercules, the protector of quarry workers, as an inscription discovered in a shrine at

the area of the ancient quarries near Karystos suggests (Chapman, 1993).

In the present study the possible astronomical orientations of the dragon houses of Laka Palli, Kapsala and Mt. Oche are examined, as well as the orientation of the gate of the Armena fortress.

The Laka Palli dragon house complex is located on the western slope of Mt. Kliosi, to the east of Styra. It consists of three buildings placed on three sides of a rectangular enclosure or courtyard, with their entrances facing onto it (Fig. 2, 3).

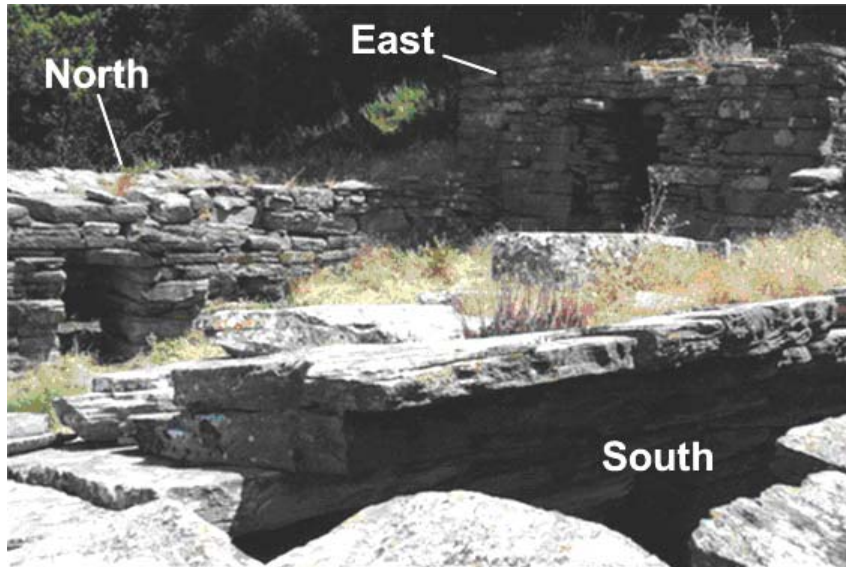


Figure 2. Laka Palli dragon houses

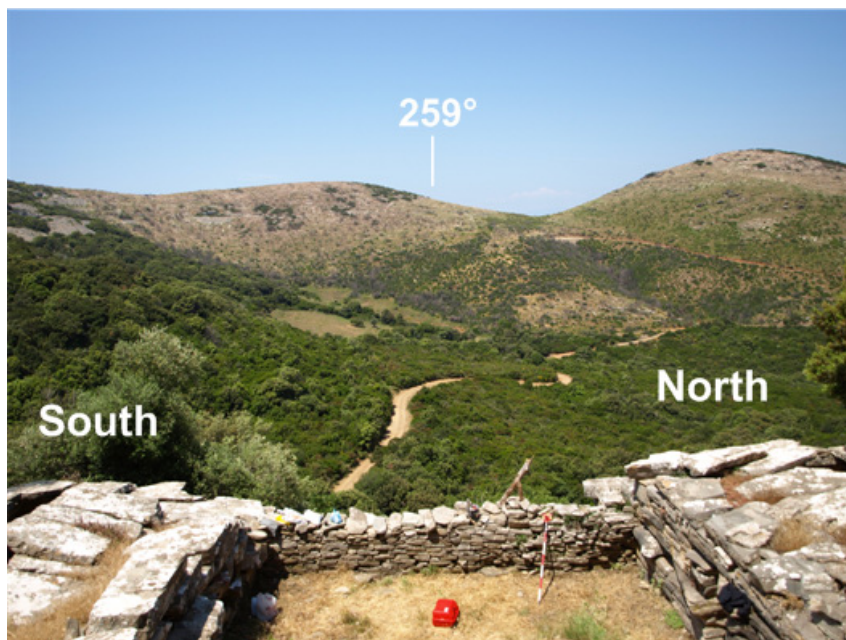


Figure 3. Looking west from the entrance of Laka Palli central (east) dragon house

We keep the names used by Carpenter and Boyd (1977), i.e. East, North and South, which correspond to the locations of the buildings in relation to the centre of the complex. The eastern (or central)

building is almost square in shape and its ceiling has an opening, called the 'opaion' (Fig. 4).



Figure 4. The hole (opaion) at the ceiling of Laka Palli central (east) dragon house

The Kapsala dragon house is located in an easily accessible position adjacent to the road that runs from Styra to Karystos and a few kilometres beyond Kapsala village. Its roof had probably collapsed and

was rebuilt in modern times. Now it consists of two separated areas, a roofed room and a courtyard. The entrance is now partially blocked by a partition wall (Fig. 5).



Figure 5. Kapsala dragon house

The dragon house of Mt. Oche is the most monumental and elaborate of the group. It is located on one of the twin peaks of the mountain and it overlooks the straight between Euboea and Andros. The excavation carried out by Moutsopoulos in 1959 unearthed ceramic vessels that range in date from the 7th century BC to Roman times (Moutsopoulos, 1982). The Mt. Oche dragon house is considered by most to be a temple (Carpenter and Boyd, 1977).

Near the Laka Palli dragon houses, at the peak of Aghios Nikolaos of Mt. Kliosi, stands the gate of the Armena fortress (Fig. 6). It is constructed of large blocks of stone, especially at the base. Unfortunately only a few of the adjacent stones of the fortress walls are still in place. Inside the fortress there is a small modern chapel, which was also examined.



Figure 6. Armena Gate, looking outwards (northwest)

METHODOLOGY

Orientation measurements were made with a magnetic compass and a clinometer, with a minimum instrument error of 0.5° (Meridian MG-3101). The geographic latitude and longitude of each site were measured with a portable GPS device (Garmin GPS III) and by Google Earth. The declination values were calculated with the GETDEC4 software.

Possible sunrise/sunset days and stellar alignments were computed with the programme Stars. Finally, representation of the ancient night sky was created with SkyMap Pro.

A recent dating project (Liritzis et al., 2009) of the stone foundations of the Laka Palli and Kapsala dragon houses and the Armena Gate dated these buildings to the 5th century BC. Therefore the date used in all celestial maps is ca. 400 BC.

Theodossiou et al. (2009) have suggested that the Mt. Oche dragon house is aligned to the rise of Sirius (alpha Canis Majoris). Since this alignment corresponds to the orientation of the right side of the building (i.e. the wall on the right as we face the entrance), we decided to measure the entrances and the right sides of the rest of the dragon houses as well, to compare our results.

RESULTS AND DISCUSSION

Dragon houses

Tables 1 and 2 show the calculated declinations for the houses' entrances and the corresponding alignments to the sun and the stars, respectively. Tables 3 and 4 show the same calculations for the right sides of the dragon houses.

The declination values that correspond to the buildings' entrances suggest that, with the exception of Laka Palli East house, none of the other buildings is aligned to a sunrise or a sunset (or the rise and set of the moon), consequently the orientation of the dragon houses probably was not connected to the sun or the moon.

Additionally, if we consider the orientation of the East house as the main orientation of the Laka Palli complex, there is no general pattern in orientation. The three sites of Laka Palli, Oche, and Kapsala look west, southwest, and

southeast respectively. On the other hand, two of the buildings, Kapsala house and Laka Palli North house, have the same southeastern alignment. In addition, the dragon house at Oche has a southwestern orientation, so there is a possibility that this broad southern orientation was deliberate.

Due to the small number of buildings investigated and their diversity in orientation, it is impossible to determine if any of the buildings had deliberate stellar alignments. There are, however, some noteworthy results to be considered. Probably the most impressive alignment is that of the Laka Palli East house to Orion's belt (Fig. 7). At ca. 400 BC the three stars of the belt would be positioned directly over the point on the western horizon toward which the house is oriented. Even if this alignment was not intended, it would hardly have been missed.

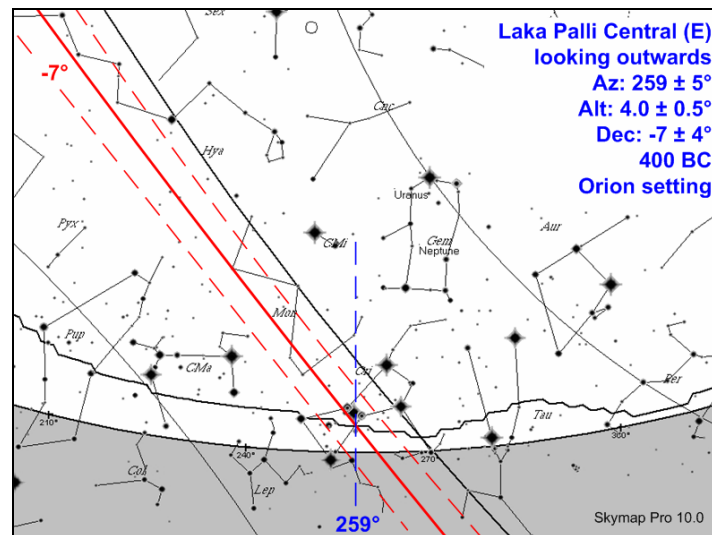


Figure 7. Laka Palli East d/house, entrance orientation. Orion setting (c. 400 BC)

The Laka Palli South house is aligned toward the head of the constellation Draco, when it would be at its lowest point in the sky. However, this view was

probably blocked by trees (and the North house) since the orientation of the South house is too close to the mountain slope.

The declination of the Laka Palli North house and the Kapsala house does not correspond to a significant star or constellation. Actually, the specific declination line (i.e., the path that any star follows in the sky) is very close and almost parallel to the horizon, so it is

unlikely that any star could have been noticed along this line. On the other hand, the constellations of Canis Major, Scorpius, and Sagittarius would pass a few degrees above the horizon of these buildings (Fig. 8).

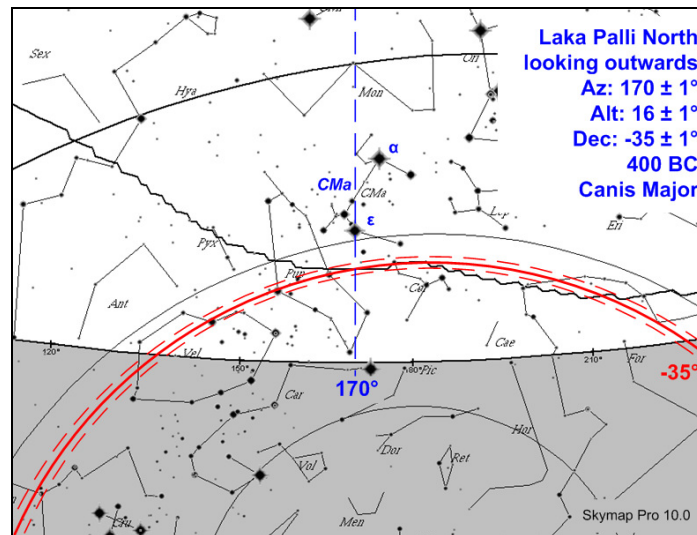


Figure 8. Laka Palli North d/house, entrance orientation. Constellation Canis Major appears a few degrees above the horizon of the d/house (c. 400 BC)

The entrance of the Mt. Oche dragon house is aligned to the constellation Crux (Southern Cross) at the time of its setting (Fig. 9). Additionally, the two brightest stars of the constellation Centaurus would also pass over this point. However, the visibility of these alignments is uncertain, since the horizon is at sea level, which could be obscured by mist. At the present time these stars are constantly below the horizon.

The study of the right sides' orientations produced the following results. While the Mt. Oche house is aligned to the star Sirius in Canis Major, as previously proposed (Theodossiou et al., 2009), and other bright constellations, none of the other buildings follow this orientation. In the case of Laka Palli, the relevant constellations are the same to

those that are visible from the entrances of the buildings, due to the layout of the complex (e.g., the orientation of Laka Palli East right side is identical to the orientation of Laka Palli North entrance). At Kapsala, only two constellations of low illumination were observed.

A special mention should be made about the 'opaion' (i.e., opening) in the ceiling of the Laka Palli East house. A view through the opening at ca. 400 BC would show many bright stars and constellations at their zenith, namely: Vega in the constellation Lyra, Deneb in Cygnus, Capella in Auriga, Hercules, Corona Borealis, Perseus, and Bootes (Fig. 10). Each constellation would be at the zenith on a different month, for a given time. Although it cannot be proven, the 'opaion' might have been used for time

observations, in addition to other possible uses (religious, social). Unfortunately, the exact size (or even the existence) of the opening in ancient times is not certain.

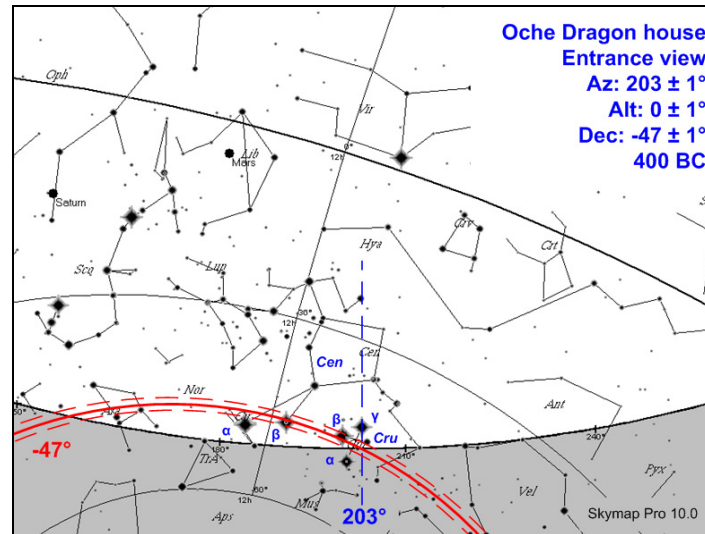


Figure 9. Oche d/house, entrance orientation. The brightest stars of the constellations Crux (Southern cross) and Centaurus set at or near this point of the horizon (c. 400 BC)

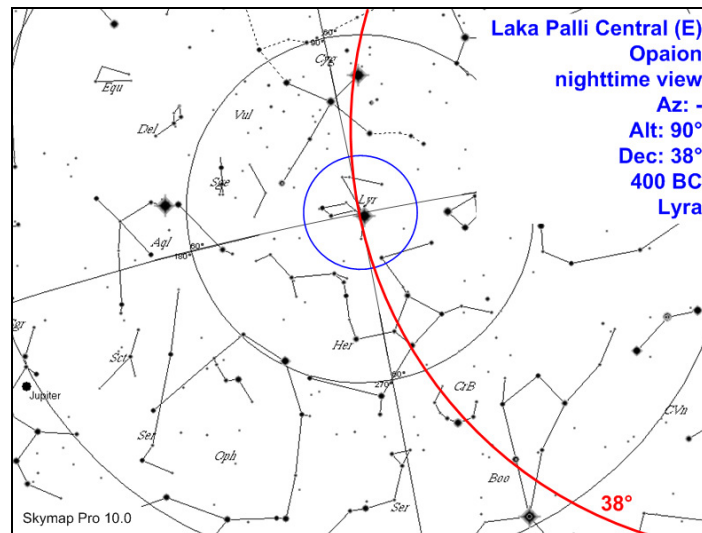


Figure 10. Laka Palli East d/house, 'opaion' view. Vega, the brightest star of the constellation Lyra is at the zenith. The constellations Cygnus, Hercules, Corona Borealis and Boötes who also pass from the zenith are visible (c. 400 BC). The inner circle has a radius of 10 degrees (altitude: 80°)

Armena gate

The Armena fortress gate has a north-west-southeast orientation, which is very close to the summer solstice sunset and the winter solstice sunrise. In fact, both solstices are within the error margins. Looking outwards (to the northwest), the

gate is also aligned to the constellations Leo, Gemini, Cancer, and Andromeda (Fig 11). In the opposite direction, the gate is aligned to the constellations Canis Major, Scorpius, and Sagittarius, as well as the peak of Mt. Oche. However, this line of sight must have been blocked by other structures inside the fortress. Thus, only

the summer solstice sunset could have been observed through the gate. Although the basic function of the site was militaristic and the gate locations may

have been dictated by the topography of the peak, this solstice association would not have passed unnoticed.

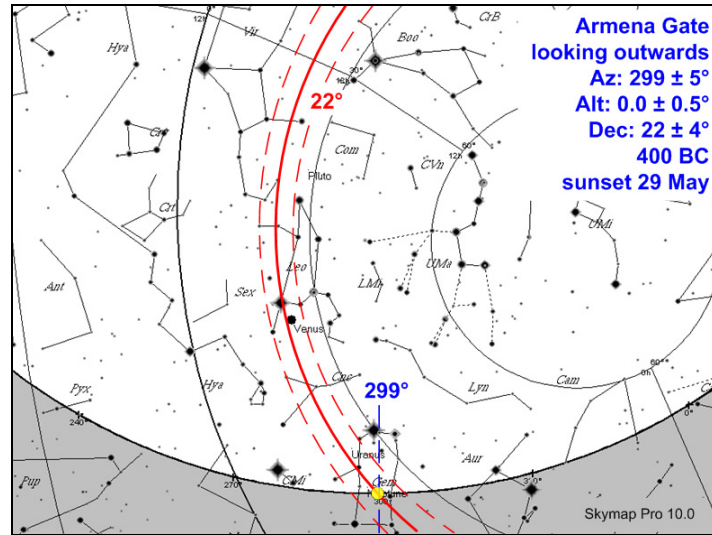


Figure 11. Armena gate, looking outwards. Sunset of May 29th (c. 400 BC). The summer solstice sunset (dec: 23.5°) is within the error margins. The constellations Gemini, Cancer and Leo who set at the gate’s orientation are visible

A group of parallel grooves on top of the rock outcrop southwest of the gate has an almost southern orientation and a declination similar to that of the Mt. Oche dragon house. The constellation Crux and the brightest stars of Centaurus would rise from that point on the horizon. In the case of the Armena gate grooves, however, the view may have been blocked by nearby buildings.

Small church

The azimuth of the church or chapel and the calculated declination show that it is not oriented within the area of possible sunrises, as might have been expected, but is a couple of degrees farther to the north. This orientation, however, does follow exactly the alignment of the mountain peak. Also, from the entrance of the church there is a clear view to the sea at the southwestern horizon.

CONCLUSIONS

As mentioned above, the small number of studied buildings does not allow us to reach a safe conclusion regarding the orientation of the dragon houses. Nevertheless, there is at least an indication that the general southern orientation of the Kapsala and Oche dragon houses is significant. This research will be expanded to include the rest of the dragon houses in the Styra area, in order to create a valid statistical group that will show which (if any) of the proposed alignments are deliberate and not as arbitrary as they currently seem.

The diversity in astronomical alignments is not the only element that separates the studied buildings. The Mt. Ochi house was built at the highest point of its landscape, while the others were not. The Laka Palli houses lie sheltered at the lower

part of a valley and the Kapsala house is located in an open area. The entrances of the Ochi and Laka Palli houses have the best overview of the nearby area, but the Kapsala house looks to the opposite direction (probably to avoid the northern winds). Thus, it is quite probable that these dragon houses were not built to serve the same functions (Carpenter and Boyd, 1977). Archaeological excavations are necessary to provide additional information about the function of each building.

In this preliminary study, no clear relationship between the investigated alignments and celestial elements pertaining to the gods Hera and Zeus or Hercules have been discovered that might support a potential cultic function for the dragon houses. The constellation Hercules, for example, appears only in one occasion, at the zenith of the Laka Palli 'opaion'.

Nonetheless, the correlation between the stars Regulus (alpha Leonis, also named Basiliscus by the Greeks) and Antares (alpha Scorpii) to the gods Zeus and Ares (Robbins, 2001), the constellation Orion to the goddess Artemis (Mair, 1921) and others require further investigation when more data become available.

Finally, the possibility that the Armena gate was deliberately aligned close to the summer solstice sunset should not be hastily rejected. The area of the fortress contains the modern church and several older chapels. Furthermore, it is known that mountain peaks were sacred places where cultic ceremonies were held (Carpenter and Boyd, 1977). The absence of any cultic activity inside the fortress during Classical and Hellenistic times seems rather unlikely. Again, new excavations could give answers to some of these issues.

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TABLES

Table 1. Entrances' orientation – Dragon houses, Armena Gate, small church φ: latitude, λ: longitude, A: Azimuth, h: horizon altitude, δ: declination, σ: error, *Orientation too close to the mountain slope, view maybe blocked by vegetation #View probably blocked by other structures

Site	φ	λ	A	σA	h	σh	δ	σδ
Dragon houses								
Kapsala	38° 7' 29"	24° 14' 42.5"	165.6	0.5	15.0	0.5	-35.2	0.5
Laka Palli E house	38° 9' 10.3"	24° 15' 49.5"	259	5	4.0	0.5	-7	4
Laka Palli S* house	38° 9' 10.3"	24° 15' 49.5"	355	1	0.5	0.5	52	1
Laka Palli N house	38° 9' 10.3"	24° 15' 49.5"	170	1	16	1	-35	1
Laka Palli opaion	38° 9' 10.3"	24° 15' 49.5"	-	-	90	-	38	-
Oche	38° 3' 31"	24° 28' 03"	203	1	0	1	-47	1
Armena Gate	38° 8' 41.2"	24° 15' 36.3"	299	5	0.0	0.5	22	4
Armena Gate (opposite)#	38° 8' 41.2"	24° 15' 36.3"	120	5	2.0	0.5	-22	4
Armena Gate parallel grooves	38° 8' 41.2"	24° 15' 36.3"	165	5	0.0	0.5	-50	4
Small church	38° 8' 44"	24° 15' 44.5"	58.5	0.5	2.5	0.5	25.8	0.5

Table 2. Possible stellar and sunrise/sunset alignments of dragon houses' entrances and Armena gate A: Azimuth, h: horizon altitude, δ : declination *Orientation too close to the mountain slope, view maybe blocked by vegetation #View probably blocked by other structures

Site	A	h	δ	Constellations (c. 400 B.C.)	Sun rise/set
Dragon houses					
Kapsala	165.6	15.0	-35.2	<i>Canis Major, Scorpius, Sagittarius, (Centaurus)</i>	-
Laka Palli E (house)	259	4.0	-7	<i>Orion, Corvus</i>	2-Mar, 10-Oct (sunset)
Laka Palli S* (house)	355	0.5	52	<i>Draco, Cepheus</i>	-
Laka Palli N (house)	170	16	-35	<i>Canis Major, Scorpius, Sagittarius, (Centaurus)</i>	-
Laka Palli (opaion)	-	90	38	<i>Lyra, Cygnus, Bootes, Auriga, Perseus, Hercules, Corona Borealis</i>	-
Oche (house)	203	0	-47	<i>Crux, Centaurus</i>	-
Armena Gate	299	0.0	22	<i>Leo, Gemini, Andromeda, Cancer, (Cygnus), (Perseus), (Auriga)</i>	29-May, 13-Jul (sunset)
Armena Gate (opposite) #	120	2.0	-22	<i>Canis Major, Scorpius, Sagittarius, (Centaurus)</i>	11-Jan, 30-Nov (sunrise)
Armena Gate (parallel grooves)	165	0.0	-50	<i>Crux, Centaurus, (Vela)</i>	-

Table 3. Dragon houses right side orientations
 ϕ : latitude, λ : longitude, A: Azimuth, h: horizon altitude, δ : declination
 *Right side of north building faces the mountain slope

Site	ϕ	λ	A	σA	h	σh	δ	$\sigma \delta$
Kapsala	38° 7' 29"	24° 14' 42.5"	75.6	0.5	11.0	0.5	18.0	0.5
Laka Palli E house	38° 9' 14.4"	24° 15' 49.2"	169	5	16	1	-35	4
Laka Palli S house	38° 9' 14.4"	24° 15' 49.2"	265	1	3	1	-2	1
Laka Palli N* house	38° 9' 14.4"	24° 15' 49.2"	80	1	-	-	-	-
Oche	38° 3' 31"	24° 28' 03"	113.2	0.5	0	1	-18.4	0.5

Table 4. Possible stellar and sunrise/sunset alignments of dragon houses' right sides
 A: Azimuth, h: horizon altitude, δ : declination

Site	A	h	δ	Constellations (c. 400 B.C.)	Sun rise/set
Kapsala	75.6	11.0	18.0	<i>Serpens, Andromeda</i>	10-May, 2-Aug (sunrise)
Laka Palli E house	169	16	-35	<i>Canis Major, Scorpius, Sagittarius</i>	-
Laka Palli S house	265	3	-2	<i>Orion, Libra, Corvus</i>	15-Mar, 27-Sep (sunset)
Oche	113.2	0	-18.4	<i>Canis Major, Orion, Scorpius</i>	28-Jan, 13-Nov (sunrise)