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THE INFRASTRUCTURE OF A HELLENISTIC TOWN AND ITS PERSISTENCE IN IMPERIAL PERIOD: THE CASE OF KOS

Monica Livadiotti*

Keywords: Kos, Hellenistic town planning, urban hygiene, drainage system, fortification, harbour, commercial installation.

Parole chiave: Kos, pianificazione urbana ellenistica, igiene urbana, smaltimento idrico, fortificazione, porto, installazione commerciale.

Abstract:

From the middle of the 5th century B.C. onwards, owing to advancements in medical science, Greek cities were planned also on the basis of hygienic principles such as the proper drainage of meteoric waters and the convenient supply of clean drinking water. Orientation was also taken into account, whereby the prevailing wind regime was observed to ensure that the streets were not too windy. Therefore, the road network was created to accommodate the climate. Furthermore, the network of drainage channels was also carefully designed to avoid water stagnating, as this was a source of epidemics. For this reason, fortifications were designed which, using special devices, facilitated the drainage of storm water. In private dwellings, the water was supplied by wells or cisterns which collected rainwater and which were usually located under the inner courtyards. From the Hellenistic period onwards, the houses were also equipped with private sanitary facilities, which diverted their waste water into the street sewers. Kos was founded in 366 B.C. following an urban Hippodamian scheme and the principles of hygiene established by Hippocrates, the physician born in Kos in the second half of the 5th cent. B.C. The Italian excavations of 1912-1945 and the more recent ones carried out by the Greek Archaeological Service revealed a complex water-supply system based on the integration, in Imperial times, of a water network established during the founding of the city. In Kos, the water supply made use of abundant natural springs located in the hills south-east of the settlement. This system remained in use during the Imperial age, and was used by the numerous baths erected during that period. Probably for urban hygiene reasons, in Kos commercial activities were mostly organised outside the city walls, in the squares at the inner port and near the eastern landing, with retail activities occurring in the streets immediately adjacent to the agora. The careful organisation of functions and of their spaces is one of the most noticeable features of the careful urban planning of the late Classical and Hellenistic periods, and Kos constitutes an excellent case-study.

Dalla metà del V secolo a.C., grazie ai progressi della scienza medica, anche la città iniziò ad essere pianificata secondo i principi dell'igiene urbana, come l'installazione di sistemi di smaltimento delle acque meteoriche e di scarico e la ricerca di buoni approvvigionamenti di acqua potabile. Si tenne conto anche dell'orientamento, osservando il regime dei venti prevalenti, in modo da evitare strade troppo ventose, disegnando la rete viaria in modo da favorire un clima ottimale; anche la rete di smaltimento delle acque meteoriche venne tracciata insieme alla rete urbana, come misura per evitare ristagni pericolosi per la salute, fonte di epidemie, il che coinvolgeva anche il progetto delle mura urbane che, con l'installazione di appositi canali, non avrebbero creato un ostacolo allo smaltimento. Nelle abitazioni private, l'acqua era fornita da pozzi o cisterne per l'acqua piovana, sistemate sotto le corti interne. Già dall'età ellenistica le case erano anche fornite di servizi igienici che scaricavano nei vicini condotti fognari stradali. La città di Kos venne fondata per sinecismo nel 366 a.C. sulla base di un piano di tipo ippodameo e seguendo i principi di igiene formulati da Ippocrate, nato proprio nell'isola alla metà del V secolo. Gli scavi italiani del 1912-1945 e i nuovi scavi del Servizio Archeologico greco hanno messo in luce un complesso sistema di approvvigionamento dell'acqua basato sull'integrazione in età romana di una rete idrica già impostata fin dalla fondazione della città, che contava su numerose sorgenti site sulle colline a Sud-Ovest. Il sistema continuò per tutta l'età imperiale e divenne funzionale anche agli edifici termali eretti in quel periodo. Probabilmente sempre per ragioni di igiene urbana, anche le attività commerciali furono per lo più organizzate fuori dalle mura, nelle piazze presso il porto interno e quello orientale, con la vendita al minuto nelle strade immediatamente vicine alla piazza agorale. L'attenta organizzazione degli spazi e delle loro funzioni appare una delle più interessanti caratteristiche della pianificazione urbana del periodo tardo classico ed ellenistico e il caso di Kos permette di tracciarne un'immagine più dettagliata.

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opportunity to share my research in a very stimulating environment, and who has undertaken the task of coordinating the papers arising from this conference. I would also very much like to thank Rita Sassu and Catherine Parnell for the invaluable help in writing my text

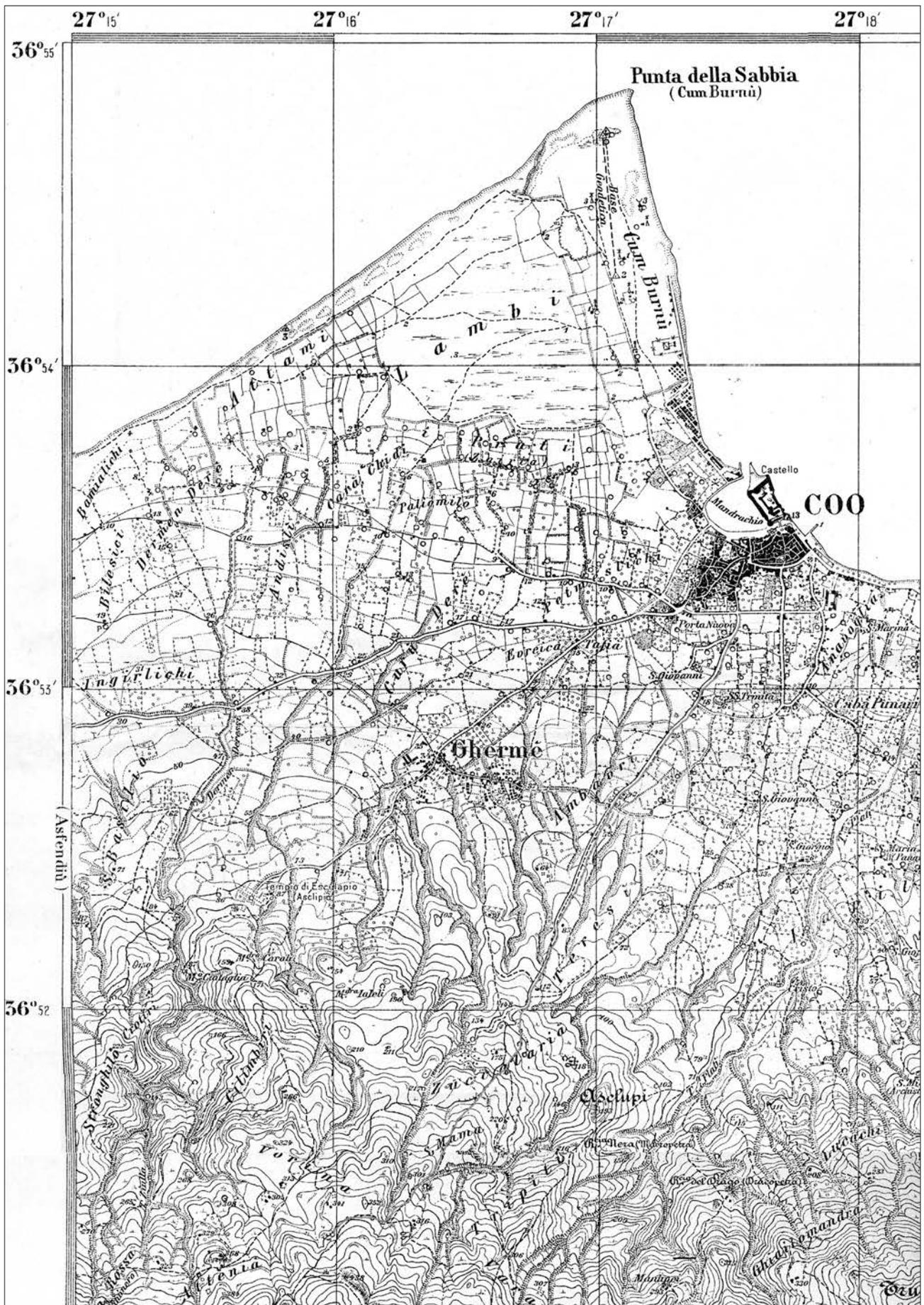


Fig. 1. Kos, map of the north-eastern sector of the island, including Cape Scandarion (Cum Burnù) and the location of Kos town (map of the Italian Geographic Institute, 1926. From LIVADIOTTI 2012).

*Kos: a brief description of the orography and the defence system*¹

Kos island is one of the largest of the Dodecanese, and its north-eastern sector (fig. 1), which ends at Cape Scandarion (Cum Burnù), in front of the western coast of Asia Minor, is a very fertile plain, sloping towards the north and east. The island is characterised by very temperate weather, owing to the prevalent north-western winds in summer, and south-eastern winds in winter. These winds determined the orography of the hill occupied by the town of Kos from the time of its first settlement; in fact, the hill, from a geological point of view, forms a dune, with a gentle slope on its north and east sides, and a relatively steep slope on the south and west sides².

Today, the Aegean region is characterised by torrential rains, which are mostly concentrated in the second half of November and in April. At Kos, the land is rich in water and, before the foundation of the city in the second quarter of the 4th century B.C.³, two seasonal streams flowed from the southern hills into a deep gulf which was always the harbour of the town. Traces of a creek bed were, in fact, uncovered during recent excavations of the Greek Archaeological Service in a central area of the city, at the southern termination of the agora and west of it⁴; it seems that these creeks were deviated towards the east when the urban fortification was built.

The town (fig. 2) was founded in 366 B.C.⁵, as a result of a synoecism between the *demes* of the island, around the natural harbour and along an important maritime route from the south-east Mediterranean to the north Aegean. Susan Sherwin White emphasises: 'The Coans' choice of site for Kos and their development of its harbour facilities leave little room to doubt that the city was founded with commerce in mind'⁶. Possibly for this same reason, the site was inhabited from the early Bronze Age⁷, and the new town was a substantial enlargement of the ancient settlement of the Geometric and Archaic periods, the Kos *Meropis* known from ancient sources⁸.

The 4th-century city was, from the beginning, protected by a strong fortification wall, with towers and protected gates (fig. 2.9). Discovered during several excavations along its perimeter⁹, the fortification was built with a double curtain of ashlar masonry with a filling inside (fig. 3a,b)¹⁰. The towers¹¹, which were built in different phases, had square, polygonal or semicircular shapes, and it seems that the former were the original, while the latter belonged to restorations carried out at the end of the 3rd or the beginning of the 2nd century¹².

In the Greek world, fortifications had not only a defensive function but also an important symbolic component, defining the urban landscape and marking the border between city and countryside¹³. Diodoros (XV, 76, 2) admires and describes these Koan walls, which were evidently built without stinting. Also the harbour quarter was defended by an independent wall circuit (fig. 2.10), comprising two different branches, struck out to the north, which surrounded the gulf and closed the port; in this way, the northern sector of the urban wall constitutes an inner defence line, a real

in an acceptable English and Patrick Klingborg for his numerous suggestions. The first part of my paper, which deals with the hydraulic systems of Kos, is a synthesis and a translation into English of a more extensive paper in Italian (see LIVADIOTTI 2012); the second part, which deals with the equipment of commerce, provides some preliminary results of new research conducted with Giorgio Rocco on ancient Kos.

¹ On the topography of the late Classical and Hellenistic city of Kos, see G. ROCCO, *Lo sviluppo urbano di Kos*, in LIPPOLIS, ROCCO 2011, pp. 292-295; Rocco 2013, pp. 17-24; G. ROCCO, *L'impianto greco-romano*, in BALDINI, LIVADIOTTI 2015, pp. 1-11.

² A. DESIO, in STEFANINI, DESIO 1928, pp. 379-380; see also LIVADIOTTI 2012, p. 95.

³ Henceforth, all dates are B.C. unless otherwise stated.

⁴ KANTZIA 1994b. Traces of the same creek bed have been noted on a road oriented north-south, which was discovered during the Svinou property excavation (GRIGORIADOU 1997a).

⁵ This date for the foundation derives from Diodoros (XV, 76). On the history of the synoecism of Kos, see SHERWIN-WHITE 1978, pp. 40-58; E. INTERDONATO, *Cos*, in CALIÒ 2005, pp. 81-91, with previous bibliography.

⁶ SHERWIN-WHITE 1978, p. 68.

⁷ MARKETOU 2004; she pointed out the presence of travelling potters in the south-east Aegean who could have used the port of Kos, which may have become a trade distribution centre (MARKETOU 1987; MARKETOU 2010, p. 763; the Late Bronze Age town, on the hill known as Seraja, is estimated at about 7.5 hectares).

⁸ On Kos *Meropis*, see SHERWIN-WHITE 1978, pp. 47-48;

KANTZIA 1988; KANTZIA 1994a. During the late 5th century B.C., Kos *Meropis* was part of a group of *poleis* of the Attic Delian league which paid tribute to Athens (HÖGHAMMAR 2010, p. 264).

⁹ For a synthesis on the Italian excavations of the city wall, see G. ROCCO, in LIVADIOTTI, ROCCO 1996, pp. 96-102, with previous bibliography.

¹⁰ The stone used was a dark grey rhyolite, locally quarried, known as *sideròpetra* (KOKKOROU-ALEVRA *et alii* 2014, pp. 33-34, with previous bibliography).

¹¹ Some towers were found by Luigi Morricone in the south sector of the town, on the Partheniadis property, and in the east sector of Città Murata (MORRICONE 1950, pp. 60-61, 243-244). On the same Partheniadis property, digging was resumed by the Greek Archaeological Service (BROUSKARI 1992a). Other towers have been found by the Greek Service in the western sector of the town, on the Lagou property (BOSNAKIS 1995), and on the opposite eastern side of the circuit during a dig on odos Astypalaia (GRIGORIADOU 2005a, 2006, 2008, 2009).

¹² Morricone dates these repairs and reinforcement works as concurrent with the Cretan War of 205-202 B.C. or the war against Philip V of Macedonia in 201-196 B.C. (MORRICONE 1950, pp. 60-61). L.M. Caliò connects the semicircular towers to an epigraphic document with a public subscription for wall restorations, which dates to 200 B.C., linking the semicircular shape of the new towers to the innovations in siegecraft introduced by Philo of Byzantium (CALIÒ 2012b, p. 188).

¹³ CALIÒ 2012a, p. 172.



Fig. 2. Kos, general map of the ancient town (from LIVADIOTTI, ROCCO 2011, fig. 1): 1. *plateia/decumanus*; 2. agora, divided into a) original south agora and b) northern added agora; 3. Central Gymnasium; 4. Western Gymnasium; 5. Northern Gymnasium; 6. stadium; 7. theatre; 8. acropolis; 9. urban fortification walls; 10. harbour fortification walls; 11. sanctuary of Aphrodite *Pandamos* and *Pontia*; 12. sanctuary of Heracles *Kallinichos*; 13. eastern *stoa* of the harbour; 14. *emporion*, or 'fish market'; 15. shipsheds; 15b. shipsheds near the Harbour Baths; 16. possible location of the *archeia*; 17. continuation of the *plateia* to the western walls; 18. possible temple at the western end of the larger *plateia*; 19. public Hellenistic L-shaped building on an open square; 20. so-called '*cardo*'; 21. 'Casa Romana'; 22. Odeion; 23. South Stoa of the agora; 24. altar in the agora; 25. Attalids' temple; 26. Imperial new entrance of the north agora; 27. aqueduct of the 2nd-3rd century; 28. late Hellenistic storerooms outside the eastern gate.

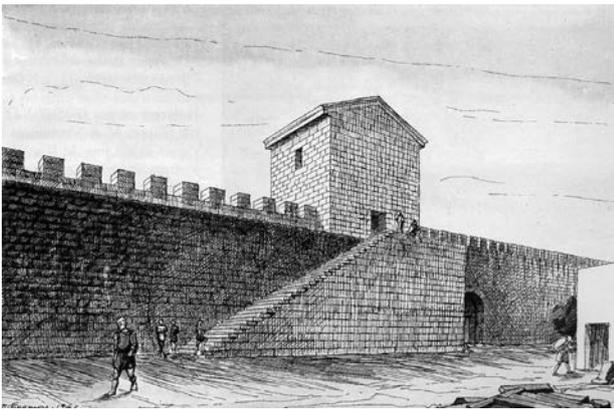


Fig. 4. Kos, the *neoria* found by the Greek Archaeological Service; now under the building of the Port Authority (from BRUSKARI 2004).

Fig. 3a,b. Kos, the fortification walls: a. the northern sector found in the archaeological site of 'Città Murata' (photo G. Rocco); b. hypothetical reconstruction by T. Finamore (from LIVADIOTTI, ROCCO 1996, fig. 205).

*diateichisma*¹⁴. The fortification of Kos encompassed an overall area of 87 hectares and had a perimeter of about 3.5 km. Added to this was the harbour zone, which was protected by the secondary wall, with an extension of another 5 hectares. Like other defensive systems known in contemporary towns – Knidos, Halikarnassos and, later, Alexandria – the harbour was probably also strengthened by a fortress situated on an islet to the north-east of the gulf, whose scanty traces have been found under the medieval castle of the Knights of St John¹⁵.

The harbour must have been ready before the last third of the 4th century because it is mentioned as a *limèn kleistòs* by Pseudo-Scylax¹⁶, whose *Periplus* was written in 338/7, prior to Alexander's accession to the Macedonian throne¹⁷. On the harbour, the defensive system was completed by other military installations such as a row of shipsheds (*neoria*) for military ships along the quay; their length was commensurate with that of the triremes, which could be up to 35-40 m¹⁸. The *neoria* have been found in two different plots; the northern ones (fig. 2.15b), in the same area where the so-called 'Harbour Baths'¹⁹ were brought to light, have been excavated by Luigi Morricone. In the brief description of the discovery, he does not seem to have identified some of the structures north of the baths as the long walls pertaining to the ancient *neoria*, and so they remained unknown to scientific literature until now. The second row of *neoria* (figs. 2.15b and 4) was discovered in more recent years by the Greek Service south of the previous plot, under the building of the Port Authority: the structures have been identified as shipsheds and dated not later than the 3rd century²⁰.

¹⁴ For the definition of the port fortification as a *diateichisma*, see BAIKA 2014. On the eastern arm, see MORRICONE 1950, p. 61; on the different spots where traces of the western arm have been found by the Greek Archaeological Service, see BROUSKARI 2004, pp. 64-65 and fig. 4.

¹⁵ MAIURI 1921-1922.

¹⁶ Scylax, *Periplus* 99.

¹⁷ Date according to SHIPLEY 2010, p. 101; SHIPLEY 2011, pp. 1-23. The port was also defined as *λιμὴν ἀξιόλογος* by Diodoros (XV, 76.2). On this topic, see LEHMANN HARTLEBEN 1923; SUSINI 1957, p. 10; 63; SHERWIN-WHITE 1978, p. 68; BROUSKARI 2004, esp. pp. 63-67.

¹⁸ On the dimensions of triremes, in general, see CASSON 1995, p. 364.

See also the experimental reconstruction of a trireme in Piraeus port in 1985-1986: MORRISON, COATES, RANKOV 2000.

¹⁹ MORRICONE 1950, pp. 219-220; LIVADIOTTI 2012, pp. 103, 110. Their long walls were found to continue westwards during an excavation by the Greek Archaeological Service on the Katsili property, carried out in 1968 by M. Nikolaidi (*ADelt* 23, 1968, p. 448). The position of the ancient structures suggests that the old coastline may have been closer and the harbour inlet larger than it is now. The location of the Hellenistic *neoria* attests, in fact, to an advancement of the current quay of approximately 22 m away from the ancient one (see also BROUSKARI 2004, p. 64).

²⁰ KANTZIA 1992b; BROUSKARI 2004; BLACKMAN 2004; LIVADIOTTI 2012, p. 109, footnote 71; BAIKA 2014. As far as their

The urban layout

Inside the main wall circuit, the town was based on a Hippodamian urban plan, which was typical of the period and followed a regular grid of *insulae*; according to this plan, the urban spaces were organised according to their function (religious, administrative, military, commercial and residential)²¹. The master plan included, besides the residential areas which were concentrated especially in the southern and eastern sectors of the city, large spaces for public monuments such as the agora (fig. 2.2a-b), with administrative buildings, sanctuaries, three *gymnasia* (fig. 2.3, 2.4, 2.5), a stadium (fig. 2.6) and a theatre (fig. 2.7), as well as commercial buildings and their *stoas*.

In the southern and south-eastern districts, the system is based on a grid of rectangular blocks oriented north-south, while the western part follows a different direction, north-east to south-west, by fitting the natural orography of the acropolis hill (fig. 2.8), on this side delimited by a retaining wall. As early as the 3rd century, the eastern side of a stadium uses the slope of the acropolis hill for the spectators (fig. 2.6). The stadium, in turn, determines the orientation of a *gymnasion* (fig. 2.4), which is located just to the west²².

In this way, the urban plan is defined by the orthogonal grid of streets and blocks and by the strict application of the principles of zoning, which are aimed at the rational definition of public and private spaces. The harbour district seems to have been destined for non-residential functions and has a different topographical distribution: here all the buildings – the sanctuary of Aphrodite *Pandamos* and *Pontia*²³ (fig. 2.11), the *propylon* of the sanctuary of Heracles *Kallimichos*²⁴ (fig. 2.12) in the east-west wing of an L-shaped monumental *stoa*²⁵ (fig. 2.13); a marketplace at the port (fig. 2.14); and the military shipsheds (fig. 2.15-15b) – are oriented around the harbour inlet in order to improve their visibility from the sea – a characteristic feature of the town, as underlined by Strabo²⁶.

The agora, which was approximately 353 m long in its final configuration, occupied 16 blocks of the urban grid²⁷. This is the result of different constructive phases: in fact, the 4th-century square (fig. 2.2a), located by the central *plateia* (fig. 2.1), which should be identified as the route of the main religious processions²⁸, at the end of the 4th / beginning of the 3rd century was joined by a further square to the marketplace near the port (fig. 2.2b). In this way, the public squares, which stretched from the centre of the town to the harbour, became impressive and extensive, covering nearly 14.000 m². The main political and religious structures of the agora, the *archeia* cited by epigraphic documents²⁹, must have been located in the southern agora, and the oldest one very probably along its western side³⁰, nearer to the acropolis, where excavations conducted on the Ioussemoglou property by Ch. Kantzia and E. Skerlou revealed an Archaic building interpreted as the *prytaneion* of Kos Meropis³¹.

length was concerned, Charis Kantzia thought that the *neoria* could have ended at a Hellenistic wall discovered on the Katzisavva-Psarrà property, 30 m to the south-west and, in that case, they could have achieved an overall length of about 50 m. The scholar, however, did not take into account that the excavation in Katzisavva-Psarrà property was inside the urban fortification and not in the harbour district. For Koan inscriptions referring to two different kinds of military ships, see SHERWIN-WHITE 1978, p. 210 and footnote 223 (*Tit. Calymnii* 64, 4-5; *Syll.* 3, 1000, 31-32). Workers assigned to haul up the ships into the docks (*νεωλκοί*) are mentioned as being amongst those who have to sacrifice to Poseidon in the sacred law *IG* XII.4, 293, dated to the late 2nd century (PAUL 2013 pp. 137-138), and this attests that the *neoria* functioned at least until that period. Besides, Tacitus (*Annales*, II, 78) mentions Roman triremes in the port of Kos in 19 AD (REDDÉ 1986, pp. 232-233). The shipsheds were abolished only in the 3rd-4th centuries A.D., and storerooms were erected on their ruins (BROUSKARI 2004, pp. 65-66).

²¹ On the urban planning theory of Hippodamos of Miletus (498-408), see CALIÒ 2012a, pp. 105-126.

²² MORRICONE 1950, p. 222; ZERVOUDAKI 1977; ZERVOUDAKI 1980; G. ROCCO, in LIVADIOTTI, ROCCO 1996, pp. 153-154; ROCCO 2013, p. 52; VALAVANIS 1999, pp. 119-141.

²³ LAURENZI 1936-1937, p. 136; MORRICONE 1950, pp. 54-57, 66-69; SHOE 1950, pp. 357, 359; COULTON 1976, p. 248; M. LIVADIOTTI, in LIVADIOTTI, ROCCO 1996, pp. 112-116; ROCCO 2004; ROCCO 2009.

²⁴ MORRICONE 1950, pp. 62-64; G. ROCCO, in LIVADIOTTI, ROCCO 1996, pp. 116-119; DE MATTEIS 2001; MALACRINO

2006; CAMPANELLI 2011.

²⁵ MORRICONE 1950, pp. 64-65; COULTON 1976, p. 248; M. LIVADIOTTI, in LIVADIOTTI, ROCCO 1996, pp. 120-121; ROCCO 2013, p. 52; ROCCO forthcoming. The east room of the east-west oriented] wing of the L-shaped *stoa* constituted the *propylon* to enter the *temenos* of Herakles.

²⁶ Strabo, *Geogr.*, XIV.657. On the argument, see also G. ROCCO, in ROCCO, CALIÒ 2016.

²⁷ This figure represents the distance between the northern fortification and the back wall of the southern *stoa* and includes the two sectors into which the agora is divided. The southern sector of the agora, the oldest, has an east-west width of 174.46 m and a north-south length of 173 m; the northern sector has an east-west width of 83.07 m (with the porticoes) and a north-south length of 181.02 m. For a synthesis, see KANTZIA 1994a. On the agora of Kos cf. LAURENZI 1936-1937, p. 137; MORRICONE 1950, pp. 71-73; SHOE 1950, pp. 351-361; MARTIN 1951, p. 408; COULTON 1976, pp. 247-248; SHERWIN-WHITE 1978, pp. 24, 224; KANTZIA, KOUZELI 1991; KANTZIA 1994b; G. ROCCO, in ROCCO, LIVADIOTTI 1996, pp. 106-112; LIVADIOTTI, ROCCO 2001; LIVADIOTTI 2006; GIANNIKOURI, SKERLOU, PAPANIKOLAOU 2011; ROCCO, LIVADIOTTI 2011; ROCCO 2013, pp. 13-21, 25, 68-69.

²⁸ On the *plateia* as a processional route, see ROCCO, LIVADIOTTI 2018; on the religious traditions in Kos, see PAUL 2013, CALIÒ 2018.

²⁹ SEGRE 1993, ED 195.7; 201.12.

³⁰ ROCCO 2013, pp. 19-21.

³¹ KANTZIA 1991; KANTZIA, SKERLOU 1997.

After the earthquake of 198, during a period of considerable wealth arising from the transformation of the *Asklepieion* into a Panhellenic sanctuary (242)³², which brought considerable wealth to the *polis*, the main monuments were completely rebuilt in white marble quarried from the Dikeos Mountain³³. Although the general lines of the original urban plan were retained, the renovation affected all the public buildings, including the Doric porticoes of the agora, which were rebuilt in a much richer and more monumental form³⁴. The Ptolemies³⁵ and, from the 2nd century, the Attalids³⁶, were patrons of this rich reconstruction. In the harbour districts, the shrines of Aphrodite (fig. 2.11) and Heracles (fig. 2.12) were also reconstructed in a more monumental way, while, in the west zone, the *gymnasion* built in the 3rd century³⁷ was enlarged during the 2nd century with an enormous porticoed courtyard³⁸ – one of the largest in the ancient world (it measured 102.13 x 196.37 m), built entirely of marble (fig. 2.4). During the same period, just south of the agora, a *gymnasion* was built³⁹ (fig. 2.3), remarkable for its location near the agora, which recalls the *gymnasia* of Miletus or Alexandria⁴⁰.

It is worth noting the hierarchical system of roads, which is typical of Hippodamian towns; this system included a unique east-west *plateia* more than 19 m wide, two important roads 9 m wide, located to the east of the agora and to the west of the Western Gymnasion, and a network of smaller secondary roads, approximately 4.5 m wide. The two larger roads, along with the *plateia*, surrounded the acropolis, and led to the agora and the *gymnasia*; these roads would have been used for the many processions witnessed by the sacred calendars related to the worship of the many Koan gods⁴¹. The excavated areas in Kos reveal that, as was normal during the Hellenistic period, the agora and the roads were not paved⁴² (cf. fig. 7c). The first paved streets appear only during the Imperial period, with the pavement limited to the main roads and spaces, such as the *plateia*, which was monumentalised in the 2nd-3rd century, not only with porticoes on its side but also with a pavement made from stone slabs⁴³. During the same period, the northern sector of the agora, which was monumentalised with a new access from the harbour, was paved with white marble slabs⁴⁴.

Even in the late Imperial period (3rd-4th centuries A.D.), this urban layout seems in its general lines the one outlined at the time of the founding, demonstrating the validity of a project that managed to meet the requirements of a rich and socially complex *polis* over time.

The water systems

In her cross-disciplinary research – one of the first attempts to study the development of ancient Greek cities from the point of view of water-management systems considering all aspects of water management⁴⁵ – Dora P. Crouch correctly concludes that a careful analysis of the ways in which the problems of water supply and the disposal of waste water are solved can provide information for an overall understanding of the city layout. In fact, the layout of the water systems can provide us with hints regarding the road layout or the disposition of public spaces, all of which are useful for architectural reconstruction. In other words, it is possible to establish clear links between the adopted form of exploitation and disposal of water and the design of the urban plan of a city. The analysis is obviously easier for

³² HERZOG, SCHAZMANN 1932; INTERDONATO 2013; BOSNAKIS 2014, with a contribution by G. Rocco and M. Livadiotti; ROCCO 2017.

³³ On the Koan white marble, see KOKKOROU-ALEVRA *et alii* 2014, pp. 31-33, with previous bibliography.

³⁴ LIVADIOTTI 2010.

³⁵ On the relationship between Kos and the Ptolemies, see SHERWIN-WHITE 1978, pp. 90-131, 135-137. Concerning an offering to Asklepios by one of the Ptolemies, see SEGRE 1993, ED 136. For a grain contribution to the *polis* from the *Philopator*, see IG XII.4 1,48b.

³⁶ On the relationship between Kos and the Attalids, SHERWIN-WHITE 1978, pp. 132-133. According to some scholars, the 2nd-century restructure of the *Asklepieion* can be interpreted as an act of euergetism by one of the Attalids (INTERDONATO 2013, p. 383, with previous bibliography).

³⁷ The *palaestra* was discovered on the Pitsi-Papakonstantinou property (SKERLOU 1997a; SKERLOU 1998a).

³⁸ For the Italian excavation of the Western Gymnasion, see MORRICONE 1950, pp. 222-224; G. ROCCO, in LIVADIOTTI, ROCCO 1996, pp. 144-148. Other parts of the huge monument were more recently investigated by the Greek Service on the

Koulià property (ZERVOUDAKI 1975), Kamaterou property (PAPACHRISTODOULOU 1987a), Siskamani-Naki property (SKERLOU 1995) and in a municipal water-supply (ΔΕΥΑΚ, ΔΗΜΟΤΙΚΗ ΕΠΙΧΕΙΡΗΣΗ ΥΔΡΕΥΣΗΣ ΑΠΟΧΕΤΕΥΣΗΣ ΚΩ) trench on Oodos Megalou Alexandrou (SKERLOU 1997b). A new architectural study is now in preparation by Giorgio Rocco, who gave a synthesis of the results in the volume in memory of Charalambos Bouras (ROCCO 2018).

³⁹ LIVADIOTTI 2016b. For its later transformation into a bath building, see LIVADIOTTI forthcoming 1.

⁴⁰ It is in fact known that, before the 3rd century, the *gymnasia* were built outside city centres (DELORME 1960, pp. 33-50).

⁴¹ ROCCO, LIVADIOTTI forthcoming.

⁴² See, for example, the many earth layers found during the excavation of the road east of the agora. These have been dated from the 4th century B.C. to the Turkish period (Damtsa property: GIANNIKOURI, SKERLOU, PAPANIKOLAOU 2011, esp. pp. 373-378).

⁴³ ROCCO, LIVADIOTTI 2018.

⁴⁴ M. LIVADIOTTI, in ROCCO, LIVADIOTTI 2011.

⁴⁵ CROUCH 1993; CROUCH 2004.



Fig. 5. Kos. Drainage channels: a. a channel found by Morricone (SAIA Archive n. M133); b. a channel found by the Archaeological Institute of Aegean Studies in 2012 in the agora (Damtsa property): the channel has been excavated on its east side and is seen from outside, with the arrow indicating the covering slabs (photo M. Livadiotti).

settlements such as Priene, which have not undergone continuous reconstructions over time; this small Ionian city, which was founded in the mid-4th century, constitutes an example of a water system which has been studied in great detail⁴⁶.

The case of Kos is rather different, as the ancient city, which was built in the mid-4th century, underwent a constant but gradual transformation from the Imperial to the Byzantine period. In this context of continuous change, the archaeological data necessary to outline, however roughly, the urban water supply during the Greek and Imperial phases are rather fragmented. In addition, the excavation reports published thus far, due to their preliminary nature, do not always provide detailed information with regard to the water systems. In recent years, we have therefore tried to provide an overview of water management in Kos from the Hellenistic period⁴⁷, hoping to provide a frame of reference for future and more systematic studies on the subject.

In general, in ancient Greek culture water should benefit all the community and, as such, it was regulated by laws enacted by the *demos*⁴⁸; hence, it was a *polis*' task to construct facilities for the provision and public distribution of water, although this was possibly supplemented by wells and cisterns on private properties, but even these were subject to public regulations⁴⁹. Moreover, the *polis* provided for the drainage of storm water⁵⁰, creating a channel network of suitable dimensions. The private households could link to the public network for the disposal of waste water from their own homes.

For the water management of Kos, we currently have no epigraphic sources regarding building regulations; however, the archaeological data provide useful information.

The drainage system

Following the advancement of medical science – mostly relating to the work of Hippocrates, who was born in Kos in the second half of the 5th century⁵¹ – it would have been clear that a planned city such as Kos had to be healthy. To achieve this, not only was the orientation of the streets taken into account, so that the roads were not too windy, but the water supply and the disposal system for waste water also had to be very carefully planned. In this respect, at Kos the influence of the Hippocratic requirements⁵² is clearly visible in the careful way the urban plan of the new city was conceived.

⁴⁶ FAHLBUSCH 2003; FAHLBUSCH 2005. In this respect also Pergamon now provides us with a good case study: see GARBRECHT 2001; WELLBROCK 2016.

⁴⁷ LIVADIOTTI 2012.

⁴⁸ MARTIN 1956, pp. 48-57; LOUIS 1982.

⁴⁹ A collection of epigraphic documents with regulations for urban hygiene in the Greek world, starting from the important *astynomoi* law of Pergamon, can be found in MARTIN 1956, pp. 48-72. For the period from Augustus to the 6th century A.D., see SALIOU 1994.

⁵⁰ ANGELAKIS, SPYRIDAKIS 1996; ANGELAKIS, KOUTSOYIANNIS,

TCHOBANOGLIOUS 2005.

⁵¹ On the relationships between medical science and town development during the late Classical and Hellenistic periods, see CALIÒ 2009.

⁵² Hippocrates, *De aeris aquis et locis* (for a commentary, see JOUANNA 2003). The concept that the water supply and its disposal are elements that affect the design of urban planning is also present in Aristotle (*Pol.* 1330b), probably as a result of the elaboration of the Hippocratic theories.



Fig. 6a-c. Kos. a. drainage channel of the north-south street east of the Central Baths. The barrel vault, dated to the Imperial period, is built on walls from a previous phase; b. drainage channel covered by a concrete barrel vault in the Western District; c. the western sector of the same drainage channel of fig. 6b, whose covering was repaired in 4th-5th centuries A.D. with architectural elements (photos by M. Livadiotti).

Given the orography of the site, with a slope from south to north and from west to east, rainwater had to be disposed of by being channelled to the sea, i.e. the closed northern harbour and the eastern shore-line, and the design of the entire road network and related drainage system seems to have taken account of this requirement. As is the case for all cities built on a natural slope (which Diodoros defines as *theatroeideis*⁵³) and surrounded by walls, in Kos it was necessary to quickly dispose of rainwater. Since the first urban layout, it would have been clear that the construction of an efficient drainage system was absolutely necessary and the excavations have revealed a complex network of channels for the disposal of stormwater which would have been carefully designed in parallel with the road network.

The drainage channels were built along the streets as early as the 4th century. Found during many of the excavations in the town⁵⁴, they were made of tufa stone slabs on the bottom and sides, and these were also used for the covers (fig. 5a,b); the covers were on the same level as the street in order to allow for cleaning and maintenance. At intervals, manholes allowed rainwater to flow into the channels. On the smaller streets, these sewers were placed at the centre of the roadway, while on the major roads they usually ran below the sidewalks.

An interesting case is a long east-west drainage channel, 45 cm wide and 85.62 m long, located 4.70 m south of the northern portico of the Western Gymnasion⁵⁵. Here, the channel was constructed to intercept and guide into the

⁵³ Dio. XIX.45.3.84. On this topic, see CALIÒ 2005.

⁵⁴ This kind of drainage channel has been found, for example, by Laurenzi in the roads east and west of the Odeion (LAURENZI 1931, p. 616) and on the road west of the theatre (L. LAURENZI, *Carta Archeologica*, record n. 16), and by Morricone near the fortifications in the 'Città Murata' (see fig. 5a). More recently, these channels have been found on the Mousaki property, on the north-western slope of the acropolis (KANTZIA 1992c); on the Svinou

property (PAPACHRISTODOULOU 1987b; GRIGORIADOU 1997a); in the street found on the Donlou property (SKERLOU 1998b, 1.10 m wide); in the north-south road found on the Milonas-Chatziantoniou-Papoutsalaki property (SKERLOU 2005b), and on the Damtsa property KM 1293h, running along the south limit of the east-west road north of the *agoranomion* (SKERLOU 2005a).

⁵⁵ Excavation carried out by Ch. Kantzia in Kamaterou property (PAPACHRISTODOULOU 1987a).

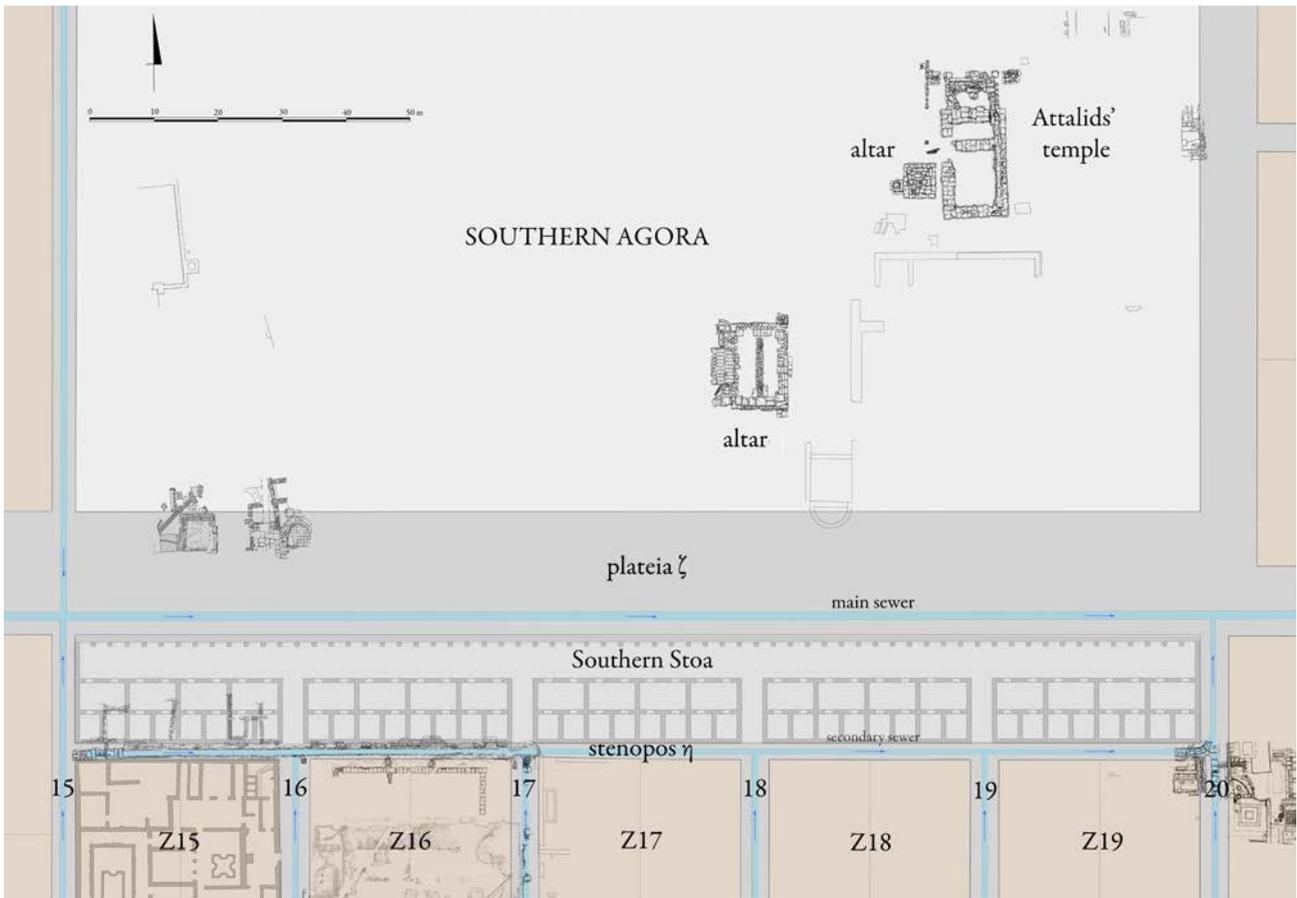


Fig. 7. Kos, southern agora: a. detail of the drainage system (from ROCCO 2013); b. the western point of origin of the channel under the *stenopos* η, view from the roof of the *insula* Z15 (from M. Livadiotti, in ROCCO 2013); c. the excavation on the Tsochas property, where the channel of the east–west *stenopos* η (1) turns (2) towards the main sewer to the north. Note also the different earth layers (3) of the north–south street, on the left, with the water pipes (4), which were continuously rebuilt (from KANTZIA 1995).

Fig. 8. Kos, eastern zone of 'Città Murata'. The northern fortification wall with an opening for drainage (photo by G. Rocco).



main channel of the street to the west the large quantity of water flowing from the huge piazza (15,000 m²), which was built sloping northwards to facilitate the disposal of rainwater⁵⁶. The channel was built in addition to the smaller drainage channels that, located at the foot of the porticoes *krepis*, collected the rainwater coming from the roofs, thus completing the drainage system of the square.

Over the course of time, this network of channels was maintained with few changes⁵⁷, although during Imperial times, because of the general rising of the street level due to several seismic episodes, the covering of stone slabs was replaced by barrel vaults made by rings of stone voussoirs alternating with concrete sections (fig. 6a), or was rebuilt entirely from concrete (fig. 6b). The excavations have brought to light many such channels⁵⁸, which were continuously repaired until the last phases of the city's life, in the 5th-6th centuries, when the ancient covering slabs or the ruined barrel vaults were replaced by architectural elements taken from the collapsed ancient monuments⁵⁹ (fig. 6c).

Like the street network, the original drainage channels were also arranged in a hierarchical way. We know the system in detail in the south sector of the agora, in the central area (fig. 7a): the first step consisted of the small collectors along the secondary streets, the *stenopoi* (fig. 7a, nrr. 15-19), into which domestic sewage poured. This waste water then poured into another sewer in an east--west *stenopos* (fig. 7b), and then into the sewer under the main *plateia* (fig. 7c); from there, it flowed into the north--south sewer of the street east of the agora; from this sewer, the excess water could be expelled beyond the city walls.

The original system was similar to that of Kassope, Priene⁶⁰, or to the drainage system of Rhodes⁶¹, which was so perfect that it was mentioned in ancient sources narrating the episode that necessitated its creation. Diodoros⁶², in fact, describes a catastrophe in 316 B.C. which was caused by torrential rain that flooded the low city of Rhodes; the solution was to open a breach in the wall to allow the water to flow into the sea. Following the incident, it was

⁵⁶ For a reconstruction of this device, see ROCCO 2018.

⁵⁷ The same phenomenon has been noted at Pergamum, where the drainage system established during the Hellenistic period remained in use with few changes throughout the Imperial period (WELLBROCK 2016, pp. 309-315).

⁵⁸ See the north-south sewer recently found in the southern sector of the agora (GIANNIKOURI, SKERLOU, PAPANIKOLAU 2011) or the one discovered in the east--west street of the excavation on the Deligianni-Balanis property (BROUSKARI 1992c). See also the channel in the Western District, here at figs. 6b,c, previously unpublished.

⁵⁹ See, for example, the sewer of the central *plateia*, discovered by Morricone in 1938 (MORRICONE 1950, p. 234): the channel, built during the Hellenistic period, ran under the southern sidewalk of the street. It was repaired in the 5th-6th century, using architectural

fragments from the dismantled Imperial portico of the *plateia* itself. See also the 4th-5th-century sewer (1.5 m wide) discovered in the courtyard of the modern hospital, which was repaired with fragments that were probably taken from the dismantled porticoes of the agora (BROUSKARI 1992d). This drain does not follow the east-west/north-south trend of the urban grid, but is oriented north-west/south-east. It signals an anomaly at this point in the urban layout which needs further investigation.

⁶⁰ For Kassope, see HOEPFNER, SCHWANDNER 1994, pp. 134-136; ISAGER 2001, pp. 109-111. For Priene, see CROUCH 1993, p. 162, plan of the drainage system at fig. 12.7; ORTLOFF, CROUCH 1998.

⁶¹ For Rhodes, see KONDIS 1963; KONSTANTINOPOULOS 1968; HOEPFNER, SCHWANDNER 1994, p. 59.

⁶² Diodoros Siculus, XIX.45.3-6.

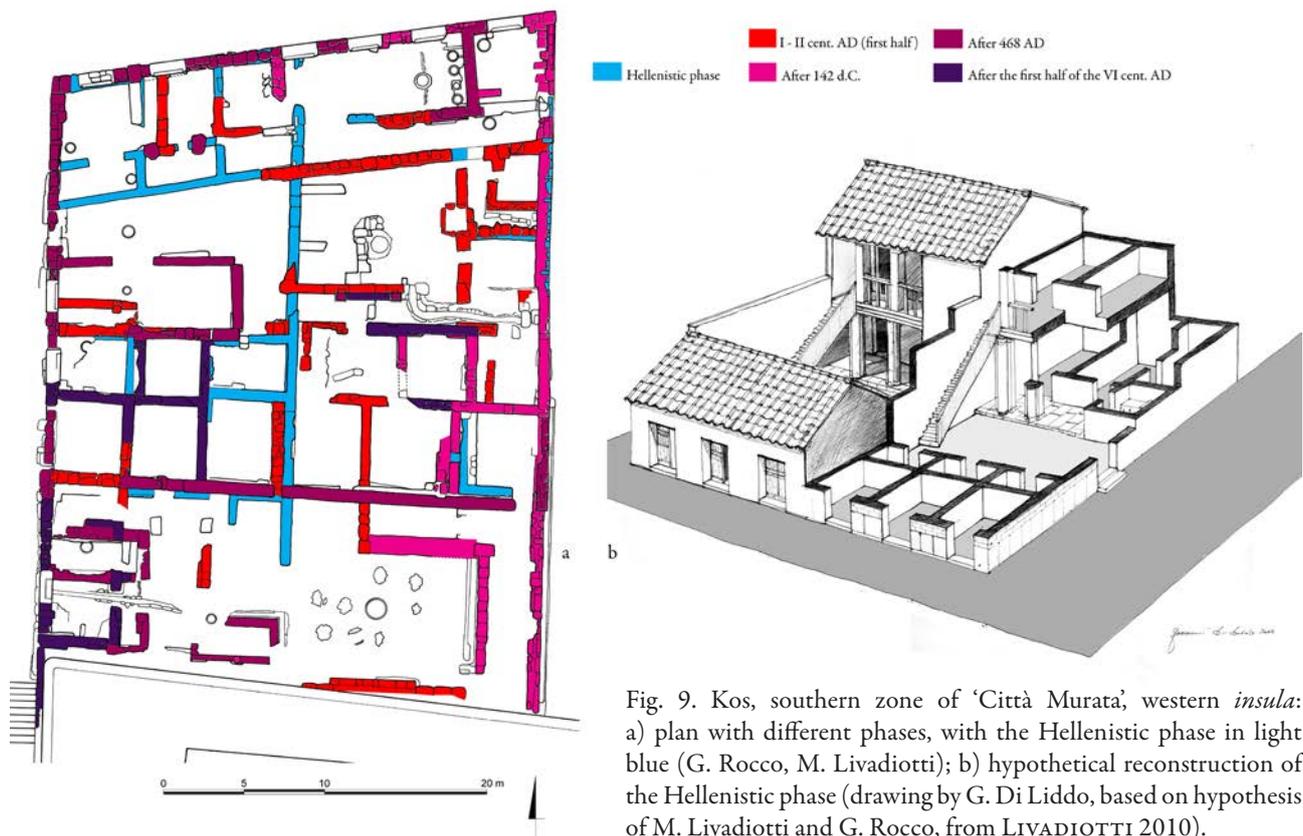


Fig. 9. Kos, southern zone of 'Città Murata', western *insula*: a) plan with different phases, with the Hellenistic phase in light blue (G. Rocco, M. Livadiotti); b) hypothetical reconstruction of the Hellenistic phase (drawing by G. Di Liddo, based on hypothesis of M. Livadiotti and G. Rocco, from LIVADIOTTI 2010).

considered necessary to develop a more effective rainwater drainage system by widening the existing one, which was evidently undersized.

At Kos, a channel, which is still visible at the foot of the mid-4th-century fortification, was built through the walls⁶³ and was intended to convey the waste water and the rainwater from the interior of the city towards the north-eastern shore-line (fig. 8), dispersing it across the plain beyond the walls. It is an important testimony to a drainage device that appears in several other fortifications of the period, such as those at Rhodes after the above-mentioned disaster, and at Thasos, Kydna, Pleuron, Ambracia, Pergamum and Rhamnus⁶⁴; the same system is also known in several cities in south Italy⁶⁵. It consists of a channel with tapered sides realized in the walls, with a smaller opening on the outside for security reasons. According to I. Kondis, the term *obeliskos* that the sources give to this type of device derives from this particular shape⁶⁶; instead, according to a generally accepted hypothesis, the term refers to metal protective grills located at the inner mouth of the drainage channels, which have been found intact in Thasos and Pergamum⁶⁷.

The public network of drains also collected the waste water flowing from the latrines of private dwellings. In Kos, because of the later transformations, which were very common in private dwellings that remained in use until the proto-Christian period, there is not much archaeological evidence for the Hellenistic period, but the sanitation facilities of Roman houses probably repeat older schemes. In fact, we know from recent discoveries on Andros⁶⁸ that Hellenistic latrines were built using the same devices that were adopted during Roman times.

From the architectural study of housing *insulae* found in the Italian excavations, it has been possible to distinguish the different phases and reconstruct the pattern of a Hellenistic house with a *prostas* (fig. 9), which can be compared to the houses at Priene, Abdera or Chyton⁶⁹. The blocks, which had an average width of 31.38 m, were, from the first phase, divided into different private houses⁷⁰, with rooms organised around an open courtyard and possibly on two floors. The entrance was always from the lateral streets, and it is on this side that we assume the

⁶³ MORRICONE 1950, p. 62.

⁶⁴ On this argument, see, in general, ADAM 1982, p. 45; HELLMANN 2010, pp. 235-238. For Thasos, in particular, see GARLAN 1966, pp. 612-621.

⁶⁵ SCONFENZA 1996, footnote 4.

⁶⁶ KONDIS 1963, pp. 76-78.

⁶⁷ GARLAN 1966, p. 621; see also LIVADIOTTI 2012, pp. 114-115

and footnote 95, with further bibliography.

⁶⁸ ANTONIOU 2007.

⁶⁹ For a synthesis, see CALIÒ 2012a, pp. 269-308.

⁷⁰ The blocks in the north-eastern part of the town were shorter and had four different dwellings each; the ones in the southern part of the town were longer and could accommodate more dwellings (see the general plan at fig. 2).

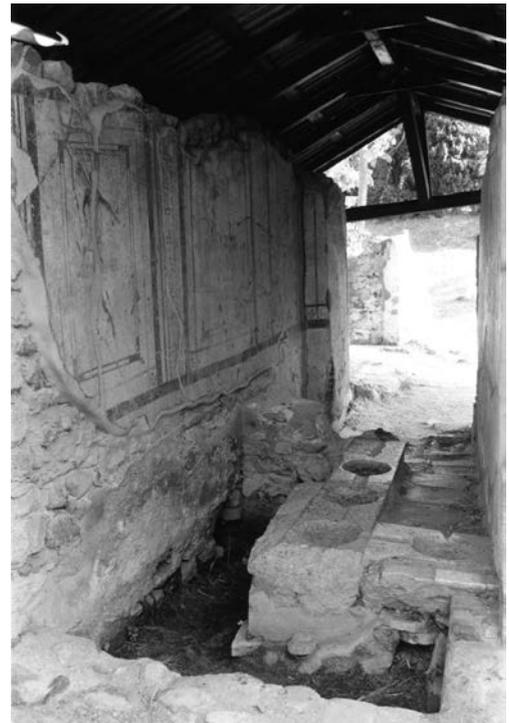


Fig. 10a-d. Kos, facilities in private houses of the Imperial period: a. 'Città Murata', the latrine in the third *insula* west of the agora: the light blue line indicates the route of the water collected in the courtyard behind; b. detail of the courtyard pavement (photo M. Livadiotti); c. the latrine on the western side of 'Casa Romana', located between the paved courtyard, on the right, and the street west of the house (photo by M. Livadiotti); d. the latrine of the eastern side of 'House of the Rape of Europe', located near the entrance and between the street east of the house and the courtyard (photo by G. Rocco).

sanitary devices were situated, in order to facilitate the discharge of sewage into the street sewer. In fact, for the same reason, during the Roman phases of the same houses, latrines were always placed near the entrance of the house, adjacent to its outer wall (fig. 10a-d). Private latrines were also not far from the inner courtyard of the houses. For the cleaning of the channel, the recycled wash water from the courtyard could be used as it flowed towards the sewer, or the rainwater coming from the roofs which was collected by channels running at the base of porticoes.



Fig. 11. Kos, clay pipes along the street south of the Odeion: observe the calcareous incrustations inside, which are about 2 cm thick and are indicated by a red arrow (photo G. Rocco).

During the Imperial period, there were also public edifices which had the same sanitary function. Sometimes rather monumental, they were connected to public bath buildings⁷¹, and, thus, in order to clean these sewers, the waste water flowing continuously from the thermal bath pools was utilised; this was a prudent use of water resources and the aim would have been to avoid wastage.

The water-supply system

In Kos, the drinking-water supply could rely on the many natural water springs located in the hills south-west of the city⁷², within a radius of about 5 km from the centre. From the springs, the water was probably brought to the city through underground pipes, which were suitable for covering the distance between the sources and town. I base this hypothesis on the well-known Greek preference, from the Archaic period onwards, for underground water-supply systems, whether tunnels dug into the rock or clay pipes⁷³. The reasons behind this preference may reside either in the will to protect the pipes from possible sabotage in case of war, or in the idea, which was deeply rooted in Greek medical thought of the Classical period, to, at all costs, preserve the purity of water⁷⁴.

In town, the water was distributed through pipelines that exploited the slight natural slope to maintain the necessary pressure⁷⁵. From the location of the natural springs, we know that, from the Hellenistic period until modern times, the water arrives at Kos from the south-west. Throughout all periods, the pipelines ran under the surface of the roads in order to protect them, as the excavations reveal⁷⁶.

Not much remains of the water system of the first urban phase, as the network was continuously used up to the Roman age and beyond; continuous renovations and replacements would have been undertaken owing also to the strong deposits of calcareous incrustations inside pipes (fig. 11)⁷⁷.

⁷¹ On the different typologies of latrines, see NEUDECKER 1994. At Kos, besides the known *latrina-nymphaeum* east of the Western Baths (MERLETTO 2000; MERLETTO 2001; MERLETTO 2004), the *latrina* near the Central Baths (LIVADIOTTI 2012, p. 121) and the one on the western side of the third terrace of the *Asklepieion* are worthy of note (HERZOG, SCHAZMANN 1932, pp. 68-69; NEUDECKER 1994, Cat. nr. 48, p. 63; MALACRINO 2005, pp. 218-223). They are all organised around a square courtyard, with seats on three sides and a fountain on the fourth.

⁷² LIVADIOTTI 2012, pp. 97-99. It is interesting to note that the same incrustation is not visible in the sewers for the waste water. This is perhaps due to the composition of the sewage, which instead leaves a sandy residue on the bottom of the channel, and the varying quality of the rainwater, which does not contain limestone salts. Instead, the same calcareous incrustation is present on the bottom of the aqueduct channel (see the arrow on fig. 15b).

⁷³ Such as the aqueduct of Pisistratus at Athens (MAYS 2010, p. 12) or the famous aqueduct of Eupalinos in Samos (KIENAST 1995; APOSTOL 2004). The latter, even if constituted by a tunnel dug into the rock, also had a clay pipe running at the bottom of the gallery.

⁷⁴ TREVOR HODGE 2005, p. 30.

⁷⁵ As evidenced by the pipes still visible along the street east and west of the *insulae* of 'Città Murata', which follow the slope of the terrain (personal observation).

⁷⁶ See, for example, the excavation in Tsochas property (see fig. 7c): KANTZIA 1995; SKERLOU 1996; CHRISTOPOULOU 1996. See also the excavation in Mylona, Papoutsalaki, Chatziantoniou property (SKERLOU 2005b).

⁷⁷ The calcareous deposits are so thick that Laurenzi erroneously thought that the limestone incrustations near the Kokkinonero spring had given rise to from the local travertine, which was mentioned by Antigonus of Caristos (fig. CLXI, 177) with regard

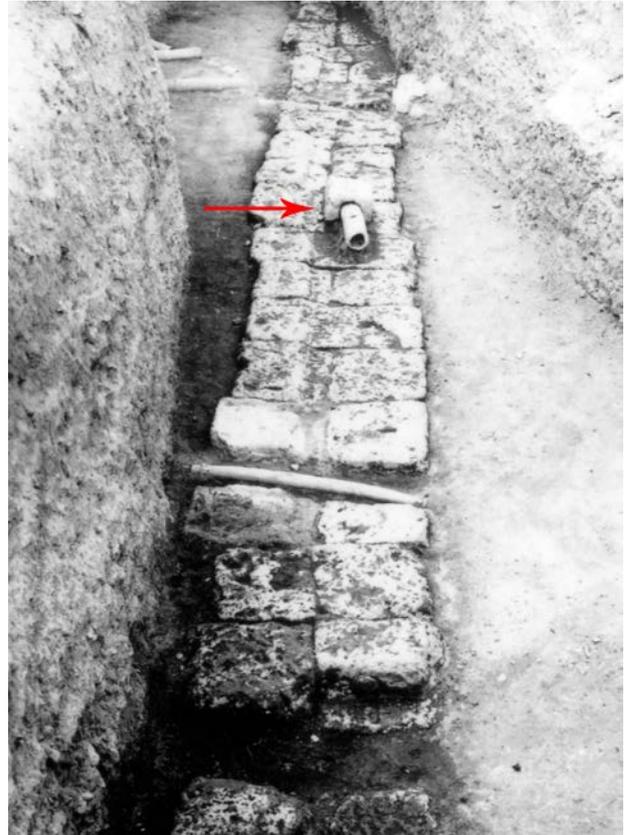
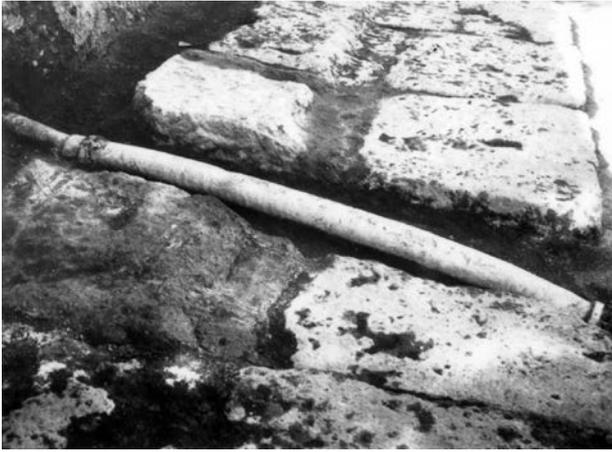


Fig. 12a,b. Kos, Western Gymnasion: a. a clay Hellenistic pipe that goes through the foundation of the northern side of the building; b. the red arrow indicates a stone junction found in the same plot (SAIA Archive, nos. M519, M522, from LIVADIOTTI 2012) (photo M. Livadiotti).

One of the few definitively Hellenistic pipes was found by Morricone in his excavation of the Western Gymnasion (fig. 12a); it is clear that the long clay pipe was built together with the foundation of the northern side of the *gymnasion*, dated to the beginning of the 2nd century⁷⁸. The finding also includes a stone junction⁷⁹ (fig. 12b), which is very similar to others found in Miletos and Ephesos. Such features were necessary to change the direction of the pipeline under heavy pressure and are evidence of the high level reached by the hydraulic technology of the period⁸⁰. The pipes were, in fact, pressurised and the water could even move up steep slopes. Similar stone junctions continued to be used during Imperial times, as a specimen found near the Central Baths indicates⁸¹.

Another characteristic of the pipe network, found in several excavated plots in Kos town, is that the pipes are often arranged in two parallel lines. Systems with double parallel pipes, placed in special trenches at the edge of roads, frequently appear in Hellenistic contexts⁸², and in Kos this device appears from the Hellenistic period onwards, as the excavations have demonstrated⁸³ (fig. 13). The device was probably useful when a pipeline had to be taken out of commission for repair: when the water circulation in one of the two tubes was interrupted, the other could continue to operate, without leaving the city deprived of water. This use of parallel pipes continued beyond the Hellenistic period, and has also been noted for the early Roman phase, as demonstrated by an excavation of the Greek Archaeological Service on the central *plateia*⁸⁴; it seems to conform to that tendency to duplication and redundancy of water systems already highlighted for the Hellenistic-Roman world⁸⁵.

As is the case in other contexts, in Kos the terracotta elements also show, at intervals, holes protected by a terracotta topping, which was fixed with lime mortar. There are two hypotheses relating to the purpose of these holes:

to the building materials of the theatre (L. LAURENZI, *Carta archeologica*, record nr. 55; the text is reproduced in LIVADIOTTI 2012, footnote 33). Instead, the ancient quarries of *amygdalopetra* have recently been identified much farther to the west, near the modern village of Pili: POUPAKI, CHATZIKOSTANTINOY 2004.

⁷⁸ MORRICONE 1950, pp. 224-227. The pipe was 1.59 m long, with reinforcement rings at the ends; the diameter was 9 cm.

⁷⁹ See LIVADIOTTI 2012, fig. 8.

⁸⁰ TREVOR HODGE 2005, pp. 37-38, 110 and fig. 61, p. 317, fig. 226; SCHWARTZ 2008.

⁸¹ LIVADIOTTI 2012, fig. 10.

⁸² TREVOR HODGES 2005, p. 30.

⁸³ The device has been found by Morricone in connection with the foundation of the Hellenistic Western Gymnasion (cf. fig. 13), in the Hellenistic north-south street on the Tsimisiri property (SKERLOU 1998c; SKERLOU 1999) and under a late Hellenistic monument on the Kephalianou property, on the northern side of the *plateia* (SKERLOU 2001-2004).

⁸⁴ Excavation in Chatzistergou-Kephalianou property (SKERLOU 2001-2004).

⁸⁵ CROUCH 2004, p. 212.



Fig. 14. Kos, a clay well found by L. Morricone in the area of the Western Baths (SAIA Archive, n. M1017, from LIVADIOTTI 2012).

Fig. 13. Kos. Double clay pipes found during the excavation of the Western Gymnasion; note also the holes on their surfaces, which are possibly Vitruvian *collivaria* (SAIA Archive, n. M520, from LIVADIOTTI 2012).

perhaps they were necessary for cleaning, or perhaps they may be identified with the *collivaria* cited by Vitruvius (*De arch.* VIII.6.5-9)⁸⁶ as devices necessary for reducing pressure and eliminating air pockets which could hinder the regular water flow. Such a system, which was used in Athens since the Archaic period⁸⁷, at Kos is attested from the Hellenistic period onwards, as the pipelines found in the Western Gymnasion demonstrate (cf. fig. 13). These holes are present in the Roman hydraulic network as well, but it is well known that Roman engineering derived in large part from Hellenistic scientific and technological acquisitions⁸⁸.

Taking advantage of the freshwater veins that ran beneath the city⁸⁹, the water supply in Kos could also rely on wells⁹⁰. The modern excavations have revealed many wells made with earthenware rings⁹¹ (fig. 14) and equipped with climbing holes to facilitate descent for maintenance, similar to those found in the agora of Athens⁹².

Besides, as was normal from the 4th century onwards (and, indeed, as the study of dwellings in Pergamum, Olynthos and Athens has demonstrated⁹³), in Kos the houses may have been equipped with underground cisterns⁹⁴ (known as *δεξαμενή*, *φρέαρ* or *λάκκος* in inscriptions and literary sources⁹⁵) for collecting rainwater from roofs⁹⁶.

⁸⁶ LIVADIOTTI 2012, p. 104 and footnote 58 for further bibliography.

⁸⁷ MAYS 2010a, pp. 12-13.

⁸⁸ For a general overview, DI PASQUALE 2004.

⁸⁹ STEFANINI, DESIO 1928, pp. 381-382.

⁹⁰ Kos Meropis also used wells, as demonstrated by the circular one found on the Ioussemoglou property, in the courtyard of a building which has been interpreted as a *prytaneion*. The well seems to have been abandoned sometime in the 5th century.

⁹¹ Besides the three wells found by Morricone in the Western District (two of them were reused in the 2nd-3rd-century bath building), another was found in the excavation of the *neoria* and connected with the harbour installations (BROUSKARI 2004, p. 68 and footnote 36). Others were found during the excavations of the Galinou property (PAPACHRISTODOULOU 1988, diameter 0.65 m), Patakou property (KANTZIA 1992d, diameter 0.55 m, inside an unidentified edifice, maybe a portico, of the Hellenistic period) and Donlou property (SKERLOU 1998b, diameter 0.50 m, in the courtyard of an unidentified building).

⁹² They were made by digging the well downwards and progressively placing the prefabricated terracotta rings, composed of three interlocking pieces: TÖLLE KASTENBEIN 1993, pp. 34-38. For further bibliography: LIVADIOTTI 2012, footnote 70.

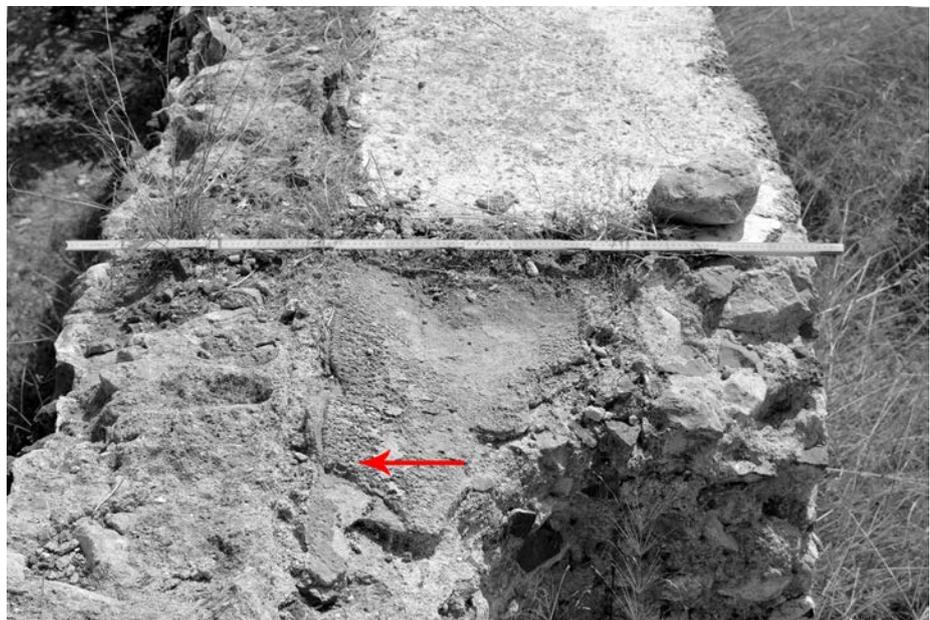
⁹³ On the argument in general, see KLINGBORG 2017. For Olynthos, see ROBINSON, GRAHAM 1938, pp. 307-309; for Athens, see CAMP 1979; for Pergamum, see WULF 1999; SABA 2009, pp. 253-254. The Pergamene private cisterns contained approximately 27/30 m³ of water each and were always efficiently maintained despite the fact that three 3rd-century B.C. aqueducts fed the town with 4.500 m³ per day (GARBRUCHT 2001, *passim*). Unfortunately, we do not have such quantitative data for Kos.

⁹⁴ At present, we have data only for the Imperial and proto-Christian phases of the same houses (see footnote 97), but it is possible that the installation of tanks was planned from the first phase. The rectangular cistern built in the south-western corner of the courtyard of the Central Gymnasion, which uses the foundation of the portico for two sides and whose other two sides were built from similar masonry (personal observations), is definitely Hellenistic.

⁹⁵ HELLMANN 1992, p. 420, n. 16; For a list of used terms, and an examination of the complexity of their meaning, see also KLINGBORG 2017, pp. 66-71.

⁹⁶ Vitr., *De arch.*, VIII.6.14. A good bibliography on this theme can be found in KLINGBORG 2017, footnote 188; he links the use of cisterns to a possible 'risk management strategy' of a Greek *polis* (p. 7).

Fig. 15a,b. Kos, the aqueduct built in the Imperial period: a. the north-south sector, from the east. Note the archways that were later closed; b. detail of the *specus* bottom; the arrow indicates the calcareous incrustations (photo M. Masiello, 2015).



As can be seen in the *insulae* brought to light in the excavations⁹⁷, these cisterns are located in the subsoil of the inner courtyards. The rainwater was conveyed into the tank directly through manholes, or from roofs through eaves, vertical pipes and drainage channels running along the perimeter of the court itself. During the Imperial period, collecting rainwater was facilitated by the courtyard paving (cf. fig. 10a,b), which was made of waterproof materials (stone or marble splinters fastened with hydraulic mortar; the same kind of pavement that we find in the bath reservoirs⁹⁸) or even mosaics⁹⁹, and laid on a slope towards the manhole at the collection point. The water contained in the tank could be drawn removed via an opening, which was sometimes protected by a parapet, a *puteal*¹⁰⁰. Some

⁹⁷ See the first *insula* east of the agora found by Morricone in 'Città Murata', where a 5th-6th centuries cistern in an *aulé* was built upon an older one, which, from its masonry, was of the Imperial period (personal observations). Some data also come from the excavation carried out on the Kassanis property (BROUSKARI 1992b): the excavation revealed part of a 5th-6th-century residence and, underneath a room in the north-eastern corner, a subterranean vaulted chamber (2.18 x 2.30 m) was found, which was accessible via a trapdoor placed in the floor of the compartment. The underground room had a floor covered with terracotta slabs and plastered walls and could have been a cistern, even if it was later reused as a tomb.

Another cistern made of *opus caementicium* (2.90 x 2.47 m) has been found on the Maravelia property, outside the southern wall of the ancient town (GRIGORIADOU 2005b); on the bottom has been observed a circular depression for cleaning (diam. 52 cm; 40 cm deep).

⁹⁸ LIVADIOTTI 2012, p. 110.

⁹⁹ See, for example, courtyard XV of 'Casa Romana'.

¹⁰⁰ In later periods, after the seismic episodes of 468 and 554 which destroyed most of the Imperial monuments, puteals were mostly made from reused architectural elements, such as column drums or bases (LIVADIOTTI 2012, p. 109).

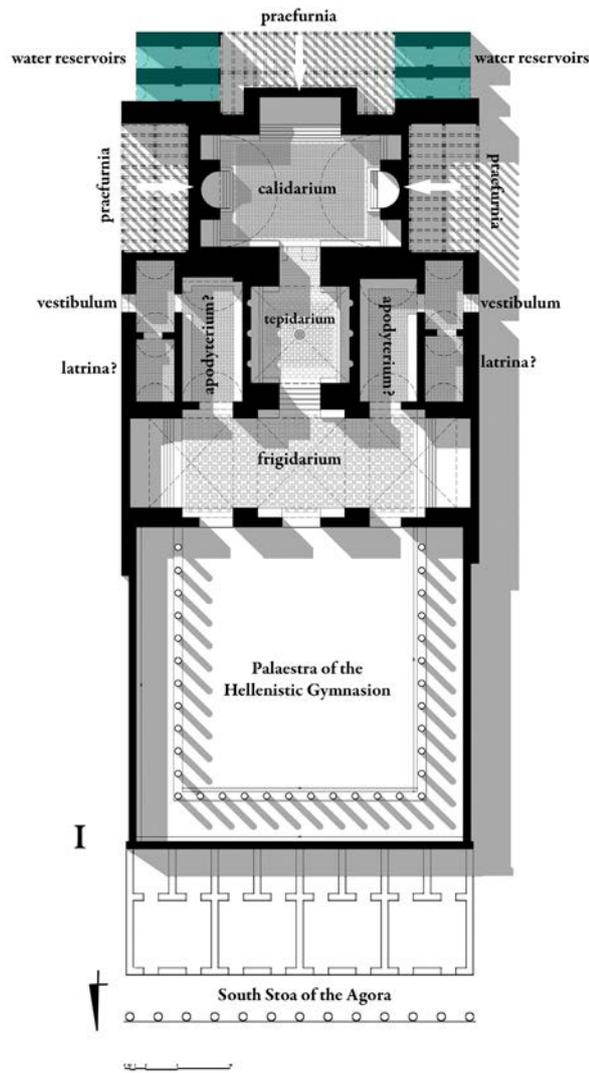


Fig. 16a-c. Kos, Central Baths: a. general map with the position of the water reservoirs, near the *praefurnia* (from LIVADIOTTI forthcoming); b. the reservoir on barrel vaults at the south-eastern corner (photo G. Rocco); c. a *castellum aquae* leaning against the outer face of the western reservoir. The arrow indicates a 'stopper' of lime that closed an earlier pipeline that fell out of use (from LIVADIOTTI 2012).

scholars believe that this water was not drinkable and was intended for domestic use only¹⁰¹. The issue is debated¹⁰², but perhaps in Kos the abundance of water coming from out-of-town springs and groundwater could have made it unnecessary to use water from cisterns.

During the Imperial period, owing to the construction of many bath buildings, the water supply needed to be enhanced. Three of these baths were built in connection with the three *gymnasia* of the Hellenistic *polis* and probably took advantage of the water systems that were already in place to serve their *loutra*¹⁰³. In order to feed the new

¹⁰¹ HELLMANN 1994, with further bibliography and the ancient sources on the argument; HELLMANN 2010, pp. 172-175.

¹⁰² *Contra*, see FORBES 2007, who notes that people drink water from cisterns in some locations in contemporary Greece. In Kos, we do not have evidence for a habit like this. On the contrary, we know that, until the first decade of the 20th century (when a new aqueduct was built by the Italian Army Corps of Engineers: MARTINOLI, PEROTTI 1999, p. 166), many houses and farms were fed by deep wells, whose water was also used to irrigate the fields. Laurenzi counted about 100 of these water installations in Kos city and in

the neighbouring countryside (LAURENZI 1931, pp. 608-609). Most have been destroyed by the modern expansion of the city, but a few of them are still visible (west of 'Casa Romana', west of the Odeion, in the field north-east of the theatre, east of the Western Gymnasion). They are usually built from reused architectural fragments and sometimes provide useful data for archaeological research (see M. LIVADIOTTI, in ROCCO 2013, p. 71 and footnote 168; for the Turkish well east of the Gymnasion, see ROCCO 2018).

¹⁰³ The Northern Baths are located immediately south of the northern circuit of the walls; the eastern part of the building was excavated by

baths, an aqueduct on arches was built in the 2nd-3rd century¹⁰⁴; its remains, with a small part of the *specus*¹⁰⁵ bottom, are still visible in the south-western district (fig. 15a,b) and attest that the direction of the water was always south-west to north-east. The aqueduct (fig. 2.27) stopped west of the Odeion, and from that point the water continued its course through terracotta pipes passing under the streets.

All thermal buildings could use water storage tanks¹⁰⁶, which were necessary for a constant flow in the bath tubs. They are always located near the main service area with *praeurnia*, because of the proximity to the boilers, as the bath built in the Central Gymnasium during the second half of the 1st century A.D. demonstrates (fig. 16a)¹⁰⁷. It has been observed that not only are the reservoirs in an elevated position to facilitate the flow (fig. 16b), but *castella aquae*, the tall pillars used to generate the required pressure¹⁰⁸ (fig. 16c), were located near them. This device was used for a long time, and we observe it even during the proto-Christian period¹⁰⁹.

In Kos, the archaeological material from the Hellenistic period includes some fountains near public places such as the *gymnasia* and near the agora¹¹⁰, and it is possible that, as was the case in other *poleis*, state officials were tasked with overseeing these fountains¹¹¹. While in the Hellenistic period water management was the responsibility of the *demos*, in Roman times it was sometimes the result of private munificence. For example, we know that, in the 1st century A.D., the water system of the *Asklepieion* was rebuilt at the expense of the rich Koan physician Gaius Stertinius Xenophon; perhaps the stamping that appears on some of the sanctuary terracotta pipes refers to the donor¹¹² (fig. 17).

Stressing the importance of fountains and *nymphaea* for civic patronage in the Roman world¹¹³, and following the example of the *nymphaeum* of Trajan in Miletus, in the second half of the 2nd century A.D., after the earthquake of 142, the northern front of the agora was rebuilt at the expense of Emperor Antoninus Pius as a form of euergetism¹¹⁴. Its southern side was organised as a *nymphaeum* with a monumental *façade* and a fountain basin, lined by Proconnesus



Fig. 17. Kos. A clay pipe from the *Asklepieion* with the stamp XENOΦΟΝΤΟΣ (SAIA Archive, n. M1094).

Laurenzi before 1933, while the digging of the western sector was completed by Morricone in 1936. The earlier *gymnasion* is known from epigraphic documents (DUBOIS 1884, 11 ff.; LAURENZI 1931, p. 612; MORRICONE 1950, footnote 57 and 221 ff.), but its structures, and the circular *loutron*, are clearly visible in the thermal rooms (LIVADIOTTI 1994; LIVADIOTTI 2004). On the Central Baths, see footnote 37. On the Western Baths, see LIVADIOTTI 2004; M. LIVADIOTTI, in BALDINI, LIVADIOTTI 2015, pp. 146-153. On the Western Gymnasium, see footnotes 35, 36.

¹⁰⁴ LIVADIOTTI 2012, p. 105, with further bibliography at note 61.

¹⁰⁵ The inner channel, which Vitruvius (*De arch.*, VIII.6.1) recommends covering in order to protect the water from the sun.

¹⁰⁶ Observable near the *praeurnia* in the Central Baths, in the Western Baths and in the Harbour Bath, they are always raised above the floor level of the thermal rooms; moreover, the bottom and the walls are covered with hydraulic mortar.

¹⁰⁷ LIVADIOTTI forthcoming I. Also, in the first phase of the Western Baths the reservoirs are located near the *praeurnia* (LIVADIOTTI 2004, M. LIVADIOTTI, *Il complesso termale*, in BALDINI, LIVADIOTTI 2015, p. 146-153), as well as in the Harbour Baths and the Northern Baths (personal observations).

¹⁰⁸ LIVADIOTTI 2012, pp. 105-106.

¹⁰⁹ As demonstrated by a 6th-century *castellum aquae* found by

Morricone in the Western District (LIVADIOTTI 2012, fig. 18).

¹¹⁰ See LIVADIOTTI 2012, p. 103. A fountain dated to the 4th century has been found north of the stadium on the Petalas property (Brouskari 1993): it is a collection basin-type fountain accessible via a short staircase. This is a type often associated with sanctuaries, such as the *Artemision* of Aulis, in Boeotia (GLASER 2000, p. 417, with previous bibliography). Similar to this fountain is that found immediately west of the *palaestra* of the Western Gymnasium, on the Pitsi-Papakostantinou property (SKERLOU 1997a; SKERLOU 1998a). An exedra fountain, which underwent extensive remodelling in the 3rd-4th centuries A.D., has been found near the south-western corner of the agora, along the northern edge of the *plateia* (GRIGORIADOU 1997b).

¹¹¹ LOUIS 1982, p. 106, concerning a passage in Aristotle (*Pol.* VI, 8, 1321b) which mentions a particular class of *ἀστυνόμοι*, the *κρηρῶν ἐπιμελητὰς*, in charge of public fountains and their maintenance.

¹¹² HERZOG, SCHAZMANN 1932, p. 56.

¹¹³ On the importance of fountains and *nymphaea* for civic patronage in the Roman world, see LONGFELLOW 2010. For a comparison, see the Antonine *nymphaeum* built on the northern side of the upper agora of Sagalassos: VANDEPUT 1997.

¹¹⁴ See the reconstruction of the monument in LIVADIOTTI, ROCCO 2011.



Fig. 18. Kos, agora, Imperial phase. The *nymphaeum* on the south side of the central hall of the northern side: hypothetical reconstruction, view from south (from M. Livadiotti, in ROCCO, LIVADIOTTI 2011).

and ‘cipollino’ marble slabs (fig. 18). Judging by the construction technique, the *nymphaeum* is coeval with the above-mentioned aqueduct and it is therefore possible that, as in Miletus, the monumental fountain in the agora was a monument celebrating the emperor’s gift of water to the *polis*.

The commercial spaces

Probably for urban hygiene reasons, large scale commercial activities in Kos were mostly organised outside the city walls, in the square near the closed port (fig. 19.2) and in an open area near the eastern landing¹¹⁵ (fig. 19.3). Port and storage areas were connected by roads to shops and craft installations (fig. 19.8). Mercantile functions were therefore peripheral to political and religious ones in a careful organisation of space¹¹⁶; this was an example of Hippodamian zoning, which was aimed at rationalising the different functions of the Hellenistic city. Such arrangement of the commercial areas of Kos was, in fact, a success and continued in use even during Roman times and beyond. Analysing in a topographical way the different areas, we begin with the central one, where old and new excavations and searches now give us a precise picture of the building phases.

The northernmost sector of the agora (fig. 19.1) was discovered by Laurenzi and Morricone in the south-west zone of the medieval town, the so-called Walled Town (the ‘Città Murata’), which was destroyed by an earthquake in 1933¹¹⁷. Its identification was also reinforced by the existence until modern times of medieval toponyms, such as *Porta tou Forou* (the western gate of the walled *chora*: fig. 19.6) or *Panaghia tou Forou*, which was a small church located nearby (fig. 19.7) that was demolished after the earthquake¹¹⁸.

In 1936 and 1943, Morricone carried out other surveys in the southern part of the modern town, looking for the southern edge of the agora. Remains of the Hellenistic eastern portico were found by Laurenzi not far from a Hellenistic temple (fig. 2.25) and an altar ‘of Dionysos’¹¹⁹ (fig. 2.24), which were known from epigraphic documents to be located in the agora¹²⁰. More recent excavations carried out by the Greek Archaeological Service have confirmed that the agora was one of the largest in the Greek world, with a length of about 353 m¹²¹.

An agora must have existed since the synoecism of the 4th century B.C., but the first archaeologically attested agora is dated to the end of the same century, modified and monumentalised during different periods¹²². The data

¹¹⁵ The archaeological surveys carried out by Morricone (MORRICONE 1950, pp. 69-70) revealed that the area east of the walls was built up only during the 3rd-4th centuries A.D. In fact, apart from a row of storerooms immediately outside the eastern gate of the walls (dated to the Hellenistic and Early Roman period, approximately from the 2nd century B.C. to the 1st century A.D.; see footnote 138), until the 3rd-4th centuries A.D. the area must have been open and flat, without many buildings between the walls and the eastern shore-line. Moreover, the sewer that from the early stage of the city passed under the walls (see *supra*) unloaded in this area.

¹¹⁶ The sanctuaries on the port, even though they were close to the commercial square, were separated from it by their own sacred enclosures.

¹¹⁷ LAURENZI 1936-37, 129-148; MORRICONE 1950, particularly pp. 71-73.

¹¹⁸ The church is still visible on the map of ‘Città Murata’ made in 1926 by the Italian Military Geographic Institute (ROCCO, LIVADIOTTI 2011, fig. 28); it was effectively situated near the western retaining wall of the stairway which gave access to the Imperial agora and was built on top of its collapsed structures.

¹¹⁹ STAMPOLIDIS 1987; STAMPOLIDIS 1991; G. ROCCO, in LIVADIOTTI, ROCCO 1996, pp. 122-125.

¹²⁰ *IG* XII, 4, 75, dated to c. 200 (see PAUL 2013, pp. 125-127).

¹²¹ See footnote 25.

¹²² There are new hypothetical reconstructions of the Hellenistic and Imperial phases in ROCCO, LIVADIOTTI 2011.

Fig. 19. Kos, map of the central area with the different spaces for mercantile activities indicated: 1. northern part of the agora; 2. market square on the inner harbour; 3. marketplace on the eastern landing; 4. *agoranomion*; 5. the new market, organised during the Imperial period; 6. the medieval *Porta tou Forou*; 7. the medieval *Panagia tou Forou*; 8. in red, the main roads where excavations discovered shops and warehouses; 9. possible trade offices; 10. deviation of the northern street during the 4th-5th century A.D.; 11. possible synagogue; 12. storerooms outside the eastern gate (elaboration by the author from ROCCO, LIVADIOTTI 2011).



from these excavations allow us to configure the agora of Kos as an Ionic agora, which was developed in different phases, with porticoes on the north, east, and west sides, and a more articulated configuration on the south-western, not excavated, side, where the open square area becomes larger and where we should expect to find the main religious and political buildings. The south side, beyond the *plateia*, was, from the 3rd century onwards, bordered by a great marble stoa, 175 m long¹²³.

While the southern part was devoted to political and religious life¹²⁴, the northern sector of the agora, being nearer to the harbour, obviously had a mercantile function. The position of the square near the port, which was practical and convenient for trading purposes, is rather common in the coastal cities of this period: for instance, Miletus, Thasos, Alikarnassos, Knidos, Iasos and Alexandria, where Strabo mentions an agora and an *emporion* near the warehouses and the *neoria* in the port¹²⁵.

In Kos, the northern sector of the east portico of the agora had rear rooms that were probably storehouses, as attested by their narrow and elongated plan¹²⁶ and also by their inner pavement which was at the same level as the portico in front of these rooms, which facilitated storage operations (figs. 20, 22a). The commercial square in the harbour district was beyond a passage in the city walls, and the storerooms on the inside of the fortification could be supplied through this access¹²⁷ (figs. 21, 22a), which was closed only in Imperial times (see *infra*).

The commercial square on the harbour was bordered by *stoas* on the south, east and west sides, as new investigations have revealed¹²⁸ (figs. 19.2, 22a,b). From the features of their architectural members and the relationship with the fortification wall, these porticoes have been dated to the late 3rd century¹²⁹. We are less well informed about

¹²³ Rocco 2013, pp. 25-27, 30-31.

¹²⁴ See footnote 28.

¹²⁵ Strabo, *Geogr.* XVII.1.9.

¹²⁶ Rickman assigns a Middle-Eastern origin to this type of elongated storerooms (RICKMAN 1971, pp. 151-155).

¹²⁷ G. ROCCO, in ROCCO, LIVADIOTTI 2011, pp. 387-391; ROCCO 2013, p. 17.

¹²⁸ G. ROCCO, in ROCCO, LIVADIOTTI 2011, pp. 387-391.

¹²⁹ G. ROCCO, in ROCCO, LIVADIOTTI 2011, p. 394.



Fig. 20. Kos. North-east corner of the agora view from south (from ROCCO, LIVADIOTTI 2011).

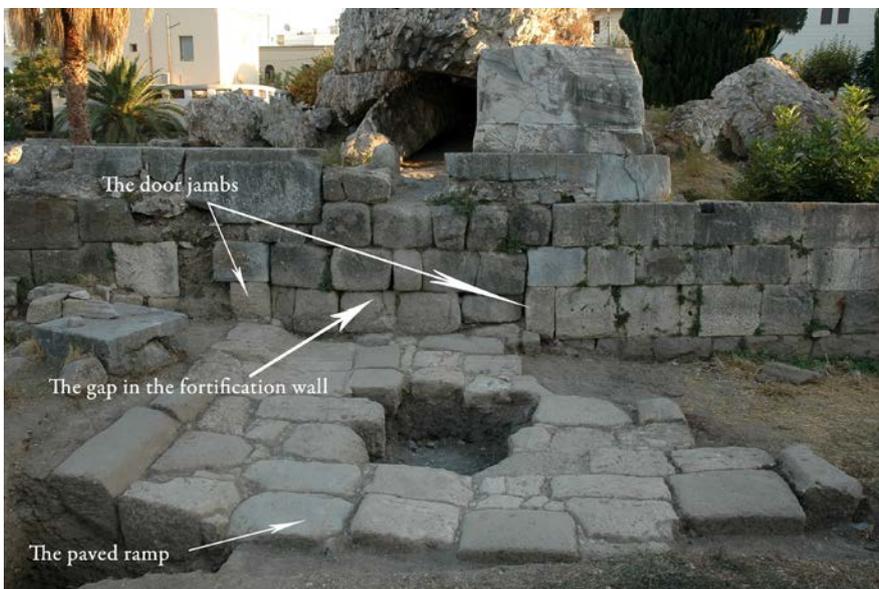


Fig. 21. Kos, the ramp and the passage in the fortification wall, closed in the Imperial period, from north (photo G. Rocco, from ROCCO, LIVADIOTTI 2011).

the north side, which has not been excavated, but it must have been very near the port quay, considering that the coastal line in ancient times was closer to this area. The square was of irregular shape and was possibly similar to the so-called ‘agora of Theophrastos’ at the port of Delos¹³⁰. A building found by Morricono under the northern part of the fortification¹³¹ may have been a precursor to the south and west *stoas* of the square on the harbour, confirming the existence of a merchant activity in the area at least from the time of Kos Meropis.

The port district of Kos may have had an international character, in which foreigners and merchants from other countries all mingled¹³². The presence of foreigners in Kos and the complexity of *polis* relations with foreign countries have recently been examined by Kerstin Höghammar, who demonstrates that Hellenistic Kos had direct and regular long-term contacts with places in other parts of the Mediterranean and Black Sea¹³³. Following the work of Alain Bresson¹³⁴, maybe this square near the quay was a *deigma*, the place where samples of goods were shown

¹³⁰ FRAISSE 1983, pp. 307-310; HELLMANN 1992, p. 29; MORETTI, FINCKER 2012.

¹³¹ LIVADIOTTI, ROCCO 2001, footnote 7 and fig. 2. The building, which is perpendicular to the western portico of the Hellenistic phase of the square, had a different orientation than the fortification. The irregular shape of the square on its west side has thus been explained by the persistence of this alignment and the reuse of the same foundation.

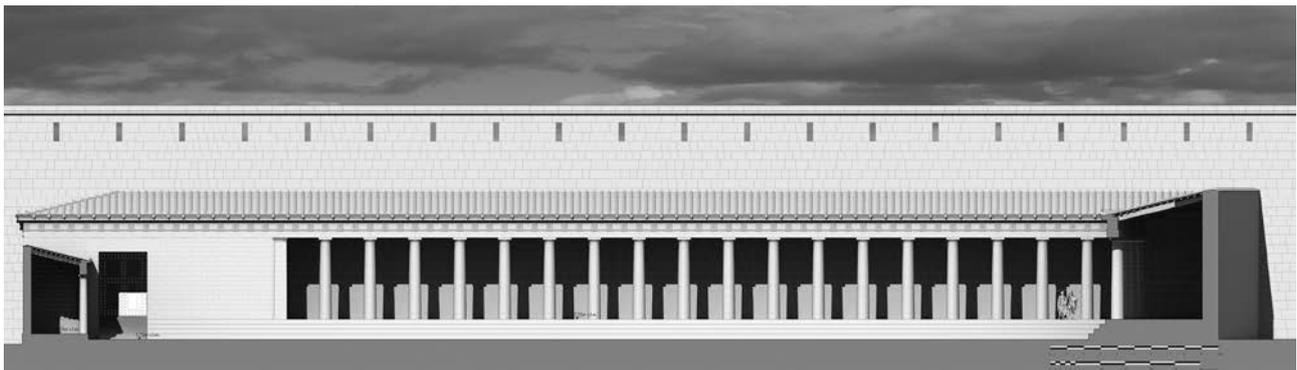
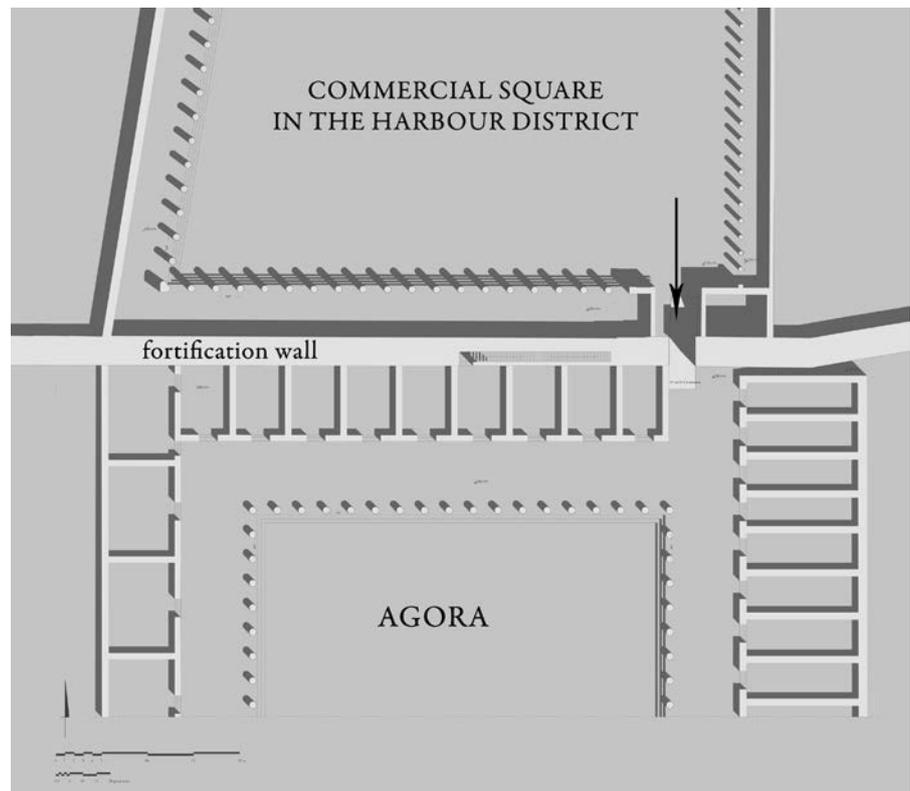
¹³² The international character of trade activity in the port of Kos

may have been much older than the same 4th-century *polis* (see footnote 6).

¹³³ See HÖGHAMMAR 2016, who – analysing the data coming from proxeny decrees, bronze coins and epigraphic documents about the recognition of the status of *Asklepieion* as a Panhellenic sanctuary – demonstrates that ‘Kos was ... a significant actor in the Greek world, not only in the immediate neighbourhood, but also in more distant areas’.

¹³⁴ BRESSON 2016, p. 310. A *deigma* could be an open space, even part of the agora, but it could also be a building. An inscription from

Fig. 22a,b. Kos: a. plan of the northern sector of the agora and the harbour market square in the 2nd century B.C.; the black arrow indicates the passage between the harbour square and the northern agora (from G. Rocco, in ROCCO, LIVADIOTTI 2011); b. harbour market square, reconstructive hypothesis of the elevation of the south side (ROCCO, LIVADIOTTI 2011).



and business transacted; the *stoas* without rooms on the rear (cf. fig. 22a) could well accommodate this function. In Rhodes, a *deigma* mentioned by Diodoros was also situated near the port because it was ruined in the same above-mentioned disaster that flooded the entire port district¹³⁵. If we accept the definition of *emporion* as a place of foreign trade that is distinct from the agora, which is a place of local trade and retail¹³⁶ (a distinction connected with the development of *polis* institutions since the Classical period), then this square located outside the urban fortification seems suitable for handling the import and export of transnational goods¹³⁷.

Returning to the civic agora, and in particular to the central and southern sectors of the eastern *stoa*, we know that the rear rooms were not storerooms like the northern ones; here, according to the excavation of the Damtsa property carried out by Charis Kantzia¹³⁸, their space is divided into two areas: an eastern zone, which is open onto the east road, and a western zone, with rooms opening onto the agora (fig. 23). The row opening onto the street seems to have had a commercial and handicraft function, which continued until a later stage, as demonstrated by the

Piraeus refers of a '*deigma* of Magnus', rebuilt by Pompey maybe after Sulla's destruction. See also DICKENSON 2016, Chap. 3.6.

¹³⁵ See footnote 62.

¹³⁶ HANSEN 1997, p. 96, but the same definition is in BRESSON 2008, *Introduction* and Chap. 4.

¹³⁷ It is interesting to note a *lex sacra* from Kos (*IG XII,4 302*) regarding *emporoi* and *naukleroi* who have to sacrifice to Aphrodite

Pandamos, whose sanctuary is in the harbour district, immediately to the east of the above-mentioned market on the port (SHERWIN WHITE 1978, p. 244; PAUL 2013, pp. 83-86).

¹³⁸ KANTZIA 1992a. The workshops have been dated to the late Hellenistic-early Roman period (from the 2nd century B.C. until the 1st century A.D.).

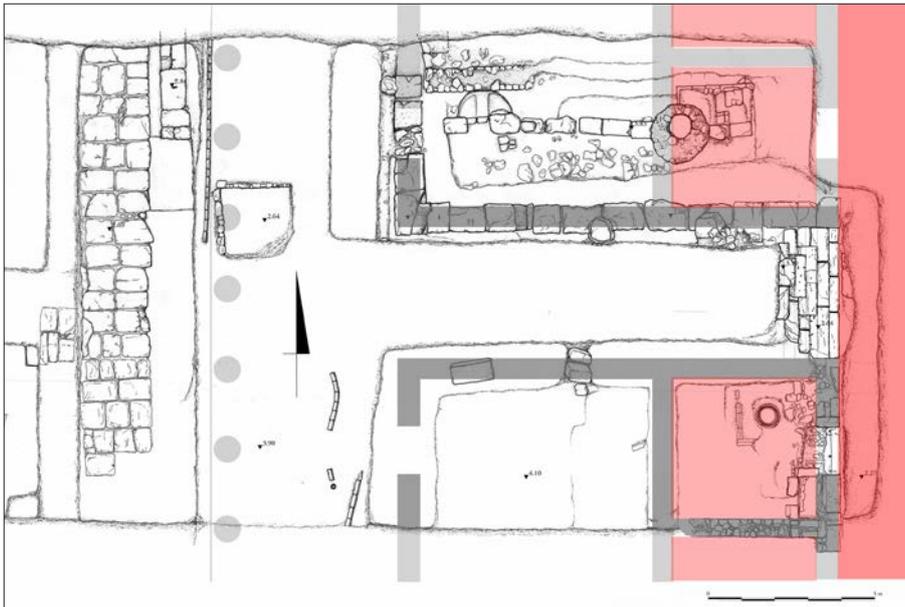


Fig. 23. Kos, Eastern Stoa of the agora, detail of the rear rooms. The ones marked in light red opened onto the street, in darker red, running east of the agora (elaboration of the author from Rocco 2013).

artisanal workshop which was used for the manufacture of colour pigments found by Kantzia in the central sector of the excavation¹³⁹.

The *agoranomion* of Kos has been identified by Elpida Skerlou near the east side of the agora¹⁴⁰ – not inside it but on the other side of the commercial road east of it (see fig. 19.4). The position of the seat of the *agoranomoi*, the magistrates who controlled all the commercial transactions, in a place which was not in direct contact with the agora suggests that its southern part was devoted to other functions, mainly political and religious ones. Despite being outside the agora, the *agoranomion* was nevertheless in a central position, near the crossing of important commercial roads, with shops and handicraft workshops, and near the main *plateia*.

The existence of different commercial places at Kos recalls the situation at Piraeus, where Pausanias mentions two different marketplaces¹⁴¹, or Rhodes, where there was one market near the port and an agora in a more central position¹⁴². At Kos, there was probably even a third market. Besides the northern part of the agora and the possible *deigma* in the harbour district, there is another possible location for unloading goods or forwarding merchandise: the eastern harbour (see fig. 19.3). Morricone found a tower, a gate and, outside it, a row of storerooms along a street leading from the gate to the shore, where there must have been another landing-place¹⁴³ (figs. 2.28, 19.12). Due to the level of the foundation, which is higher than that of the walls, the construction is later than these. However, the stone material (tufa for the foundation and travertine for the elevation) and the building technique, an ashlar masonry, of the lower part of the walls led Morricone to the conclusion that it could date to the late Hellenistic period. The building was restored during the Roman period, as evidenced by the upper part of the walls, where the stone elements are bonded with mortar¹⁴⁴. The excavation was then interrupted, and we do not know the overall length of the building, but it is possible to postulate, at least from the late Hellenistic period, an entrance into town from an eastern harbour that was flanked by this building.

¹³⁹ KANTZIA, KOUZELE 1991. Beads of Egyptian blue pigment have been found above a floor made of square brick (*pedales*), whose use spread throughout Kos from the 2nd-3rd century onwards.

¹⁴⁰ SKERLOU 2005a. On *agoranomoi* in Kos, attested at least from the end of the 3rd century onwards, see SHERWIN-WHITE 1978, pp. 212-213; see also *IG XII 4.2* nr. 480 (HÖGHAMMAR 1993, nr. 33, pp. 46-47), for a dedication to Eirene by three *agoranomoi*, which is dated to around 200, and *IG XII 4.2*, nr. 581, which is dated to the 2nd century.

¹⁴¹ Paus. I.1.3. The commercial agora was situated near the Makra Stoa, on the east side of the Kantharos harbour. See STEINHAEUER 2000, pp. 84-87; STEINHAEUER 2007, p. 201.

¹⁴² HOEPFNER, SCHWANDNER 1994, p. 51-67.

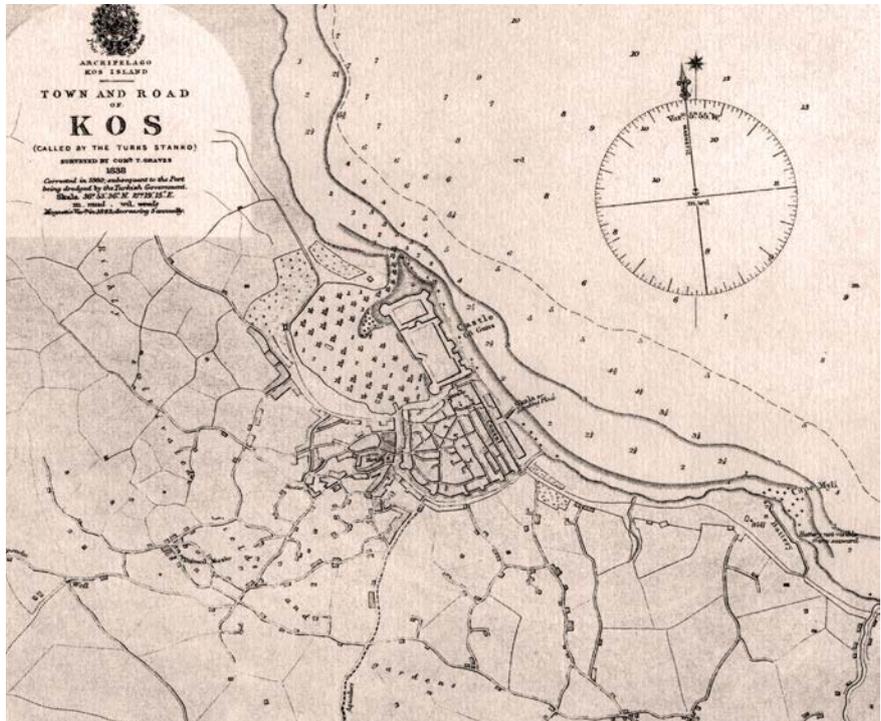
¹⁴³ MORRICONE 1950, p. 60 (the tower), p. 69 (the row of storerooms, 6.50 m deep, that was excavated for a length of about 48 m).

¹⁴⁴ The use of lime mortar in the filling and between the stone blocks of the wall facings is attested at Kos from at least the 1st century A.D. (LIVADIOTTI 2005). During the Roman period, the mortar used as aggregate a local volcanic sand, a sort of *pozzolana* (*pulvis puteolanum*), whose deposits have been noted by Morricone on the Eleona and Langada plots, south-west of the modern town (MORRICONE 1950, p. 323; LIVADIOTTI 2005, footnote 32 with further bibliography). This is a clear indication that the technique was imported by Roman builders, since the first attested use of *pozzolana* in the Eastern Mediterranean dates back to the construction of the port of *Caesaraea Maritima*, built by Herod of Judaea between 25 and 15. The *pozzolana* for the *opus caementicium* of its quays was directly imported from Campania by Roman builders, which followed Vitruvian prescriptions (*De arch.* V.12) for this kind of building (HOHFELDER, BRANDON OLESON 2007, p. 414).

Fig. 24. Kos, the 'Piazza del Platano' at the end of the 18th century (from CHOISEUL-GOUFFIER 1782, pl. 105). Before the construction of the Italian 'Palazzo della Reggenza', this square was in direct contact with the eastern landing.



Fig. 25. Kos on a map of the British Admiralty of 1838 (from MARKOGLU 2004).



Here, there was possibly a space for loading and unloading goods that was larger and more accessible than in the inner port district, where the quay was also occupied by religious buildings and military shipyards.

At Kos, we have often found the traditions regarding the use of urban spaces to be remarkably persistent¹⁴⁵, and this area near the eastern shoreline was used as a place of exchange and commercial traffic also in the medieval and turkish Nerantzia periods¹⁴⁶, since it was depicted as being very near to the marketplace in the *chora*, the 'Piazza del Platano', in images of the 19th century (fig. 24). In fact, before the construction of the 'Palazzo della Reggenza', the administrative building built in 1927¹⁴⁷, the 'Piazza del Platano' was in direct communication with 'Piazza Marina' on the eastern shore. As a map by Francis Beaufort testifies, at the beginning of the 19th century the closed harbour was unusable because it had been reduced to a marsh¹⁴⁸. On a map of the British Admiralty of 1838 (fig. 25), we can note the closed port represented as a swamp and the existence of the eastern landing, which remained in use until the first Italian period (fig. 26a,b), when the closed harbour was dredged and restored¹⁴⁹.

¹⁴⁵ See LIVADIOTTI 2016a.

¹⁴⁶ This was the name, derived from the extensive orange groves that surrounded Kos, by which the town was known at that time: KONTOIANNIS 2001, p. 413; BROUSKARI 2004, footnote 2.

¹⁴⁷ MARTINOLI, PEROTTI 1999, pp. 205-206. The palace was

designed in 1926 by the Italian architect Florestano Di Fausto.

¹⁴⁸ BEAUFORT 1817, map between pp. 80-81, where he fits into the drawing of the inlet the words 'shallow waters, perhaps the ancient port', and description at p. 91.

¹⁴⁹ On this argument, see LIVADIOTTI 2016a.



Fig. 26a,b. Kos. a. the eastern landing from the east in 1927 (from EGIDI 1927, p. 2); b. the same eastern landing during the boarding of a load of grapes (from STEFANINI, DESIO 1928, p. 417).

During the Imperial period, the mercantile activities in the commercial square of the inner port had to be transferred elsewhere. In fact, the earthquake of A.D. 142 resulted in serious destruction, and the agora required repairs. Together with the restoration activity, the destruction became the occasion for an extensive reconstruction of its northern part with the realisation of a monumental access from the port (fig. 2.26). To do so it was necessary to dismantle the corresponding sector of the northern city wall, which may have already partially collapsed¹⁵⁰; the 4th-century fortification, which had to be used as a foundation for the new monumental front, was left at a uniform level of 3.70 m above sea level. On this occasion, the ancient passage to the harbour was closed (cf. fig. 21) and substituted by a new marble *propylon*, with many vaulted passages on each side of a monumental central hall¹⁵¹. The building was raised on a wide terrace, which was accessible via a broad marble stairway more than 50 m wide (fig. 27).

This transformation created a huge public space, a great agora-forum, which extended from the port to the ancient *plateia*; the new north building kept the agora in direct communication with the harbour, not for commercial purposes, but rather to increase the splendid image that the city projected to visitors arriving from the sea. During this period, it seems that the function of the northern sector of the agora and its relationship with the harbour were deeply altered: the original market was replaced by a monument of representative type and strong visual impact, in keeping with the provincial Imperial constructions due to the euergetism of the emperors¹⁵².

¹⁵⁰ Also, the southern sector of the walls seems to have been dismantled during the same period. Morricone wrote in his notes that the tower he found on the Partheniadi property was destroyed in the Antonine age (G. ROCCO, in LIVADIOTTI, ROCCO 1996, p. 100). On the general phenomenon of the dismantling

of fortifications in Asia Minor during the Imperial period and especially during the Antonine period, see CAPUZZO 2012.

¹⁵¹ For the reconstruction, see M. LIVADIOTTI, in ROCCO, LIVADIOTTI 2011, pp. 401-422.

¹⁵² See also LIVADIOTTI forthcoming 2.



Fig. 27. Kos, agora: the reconstructed northern front viewed from the harbour (drawing: arch. S. Valentini, based on G. Rocco and M. Livadiotti's hypothesis).

Because of this general transformation, the ancient marketplace in the harbour (figs. 2.14, 19.2) lost its porticoes, but received in this phase a new pavement, made of white marble slabs. The new paved square on the harbour could no longer maintain its commercial function, which must have been transferred elsewhere.

In fact, one of the *insulae* to the east of the agora (fig. 19.5) was, during the same period, adapted for commercial purposes. The original residential structure was replaced by a building, accessible from the north, with an open courtyard with porticoes overlooked by *tabernae* and handicraft spaces. Other *tabernae*, and possibly a *caupona* in the room at the north-east corner, overlooked the northern street. At the centre is a long row of storerooms, covered with barrel vaults that support a large reservoir¹⁵³. The building is composed of two series of compartments arranged back-to-back and separated into two blocks by a narrow corridor¹⁵⁴. At the short sides of the central building, two fountains used the water coming from the reservoir (fig. 28a,b).

Research is at a preliminary stage, but, in my opinion, this building could be a market or even a *macellum*¹⁵⁵, which was intended to replace the ancient *deigma* in the inner harbour. It was located not far from the agora and on one of the ancient commercial roads of the town centre; thus, it was in a prime position for communication with the eastern harbour, which in this period could have been even more important than it had been in previous periods. The building's position near the harbour finds analogies in the commercial agora of Keramos in Caria¹⁵⁶ and in the so-called '*plakoma* of Andriake', with its *horrea*¹⁵⁷, both of which have been dated to the 2nd century A.D. Even if the typology is far from that of the monumental *macella* of the western provinces, it is possible that, in the Eastern Mediterranean, markets existed in other shapes¹⁵⁸ and our buildings have an inner arrangement (though much smaller in scale) similar to that of many *horrea* of Ostia¹⁵⁹ (fig. 29).

¹⁵³ The pavement of the reservoir is at 6.05 m above sea level whereas the courtyard is at a medium level of 2.50, which is commensurate with the level of the northern road in the 2nd-3rd century A.D. In fact, during the Hellenistic period the road was lower by about 80 cm (MORRICONE 1950, p. 71).

¹⁵⁴ The second pair of rooms from the south was transformed in medieval times into a church, by demolishing the inner wall and adding an apsis on the east side.

¹⁵⁵ In most cases, the *macellum* was situated facing one side of the forum or close to it, although on a main road axis (DE RUYT 1983, p. 326 ff.).

¹⁵⁶ SPANU 1997, pp. 92 ff. The complex, a courtyard surrounded by porticoes on two sides with *tabernae* on the third, was in a peripheral area of the town, near the fortification and the harbour.

¹⁵⁷ WÖRRLE 1975.

¹⁵⁸ SPANU 1997, p. 99 and footnote 12 for different opinions about the etymology of the term *macellum*/μάκελλον. For a catalogue of the micro-Asiatic examples, see ΑΤΙΚ 2008.

¹⁵⁹ As the Great Horrea of the *Regio II - Insula IX* (II,IX,7) or the smaller *horrea* of the *Regio I - Insula VIII-I.VIII.2* or, again, the so-called '*Piccolo Mercato*' of the *Regio I - Insula VIII* (I.VIII.1).



Fig. 28a,b. Kos, southern zone of 'Città Murata', second *insula* from the west: a. plan with different phases, with the Hellenistic phase in light blue (from LIVADIOTTI 2012); b. the central warehouse with the reservoir on the top and the fountain at the extremity (photo M. Livadiotti).

Other shops and *tabernae* were organised during the Imperial period in the northern sector of the adjacent *insula* to the west, while on the other side of the northern street, after the second half of the 2nd century A.D. and when the fortification had been demolished, a building was built on its ruins (figs. 19.9, 28a), leaning on the rear southern wall of the *Aphrodision*. Morricone thought that, since it was composed of a series of five or six large rooms, opened to the road and paved with fine mosaics dated to the second half of the 3rd century, the building was a house¹⁶⁰; however, its plan suggests that it may have housed trade offices (*stationes*), such as the inner rooms of the porticoes around the ‘Piazza delle Corporazioni’ in Ostia¹⁶¹.

During Imperial times, all of this sector of the road (fig. 19.8), extending for at least 70 m, had a commercial purpose, and its function of connecting the agora and the eastern port became so important that, from the 4th century A.D. onwards, its easternmost path was straightened (figs. 19.10, 28a), just to shorten the distance from the coast¹⁶². It is well worth remembering that, from the beginning of the 5th century, Kos’ harbour was one of the stopping points of the *annona*¹⁶³ en route from Alexandria to Constantinople, and the most direct way of reaching the agora from the eastern shore was to follow this new road.

In conclusion, the knowledge acquired over the past years about Kos makes it possible to better delineate its infrastructure network: the roads, the public areas, the defence system, the water supply, the waste water drainage and the mercantile spaces. This network was maintained with few adaptations between the Hellenistic and the Imperial periods and therefore Kos constitutes an interesting case study. However, future archaeological investigations will surely refine this analysis, which remains preliminary.

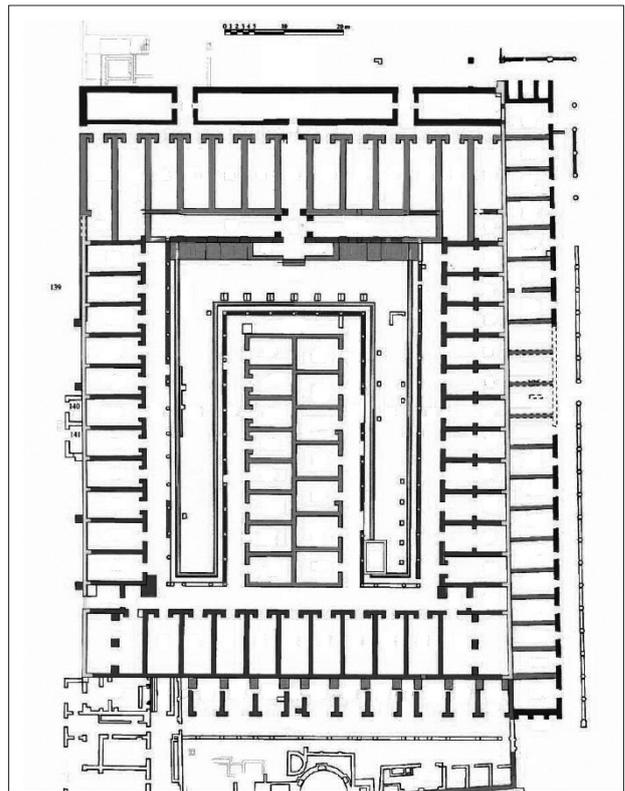


Fig. 29. Ostia. Plan of the *horrea* of the *Regio II - Insula IX* (elaboration from BUKOWIECKI, MONTEIX, ROUSSE 2008, fig. 39).

¹⁶⁰ MORRICONE 1950, pp. 68, 70. On the mosaics with hunting scenes, see DE MATTEIS 2004, Cat. nr. 37.

¹⁶¹ CALZA 1916; BECATTI 1961, pp. 64-85; TERPSTRA 2013, pp. 100-117.

¹⁶² As it is evident in fig. 28a, the ancient internal road that passed along the walls, was obliterated by a building datable to the first half of the 4th century. Furthermore, on the dismantled sector of

the east harbour fortification, between the 4th and 5th centuries (according to MORRICONE 1950, p. 70), an apsidal building was built (fig. 19.11), which has been interpreted as a synagogue (D. PELLACCHIA, *L'edificio a est del quartiere*, in BALDINI, LIVADIOTTI 2015, pp. 48-51).

¹⁶³ DELIGIANNAKIS 2008, pp. 213-215, 218-222; I. BALDINI, in BALDINI, LIVADIOTTI 2011, pp. 42-44.

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