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KILIKIA ARKEOLOJİSİNİ ARAŞTIRMA MERKEZİ

BİLİMSEL SÜRELİ YAYINI 'OLBA'

Amaç

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Dipnot (kitaplar ve makaleler için)

Richter 1977, 162, res. 217.

Diğer Kısaltmalar

age.	adı geçen eser
ay.	aynı yazar
vd.	ve devamı
yak.	yaklaşık
v.d.	ve diğerleri
y.dn.	yukarı dipnot
dn.	dipnot
a.dn.	aşağı dipnot
bk.	Bakınız

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'RESEARCH CENTER OF CILICIAN ARCHAEOLOGY'

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Olba is printed once a year in May. Deadline for sending papers is the end of November each year.

The Journal 'Olba', being published since 1998 by the 'Research Center of Cilician Archeology' of the Mersin University (Turkey), includes original studies done on prehistory, protohistory, classical archaeology, classical philology (and ancient languages and cultures), ancient history, numismatics and early christian archeology of Asia Minor, the Mediterranean region and the Near East.

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   d. Titles within the article should be written in small letters and be marked as bold. Other choises (big letters, underline or italic) should not be used.

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Footnotes (for books and articles):

Richter 1977, 162, fig. 217.

Miscellaneous Abbreviations:

op. cit.	in the work already cited
idem	an auther that has just been mentioned
ff	following pages
et al.	and others
n.	footnote
see	see
infra	see below
supra	see above

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THE OLDEST STONE BRIDGE OF ANATOLIA: THE TARSUS BRIDGE

İlkay GÖÇMEN *

ÖZ

Anadolu'nun En Eski Taş Köprüsü: Tarsus Köprüsü

Kilikia Bölgesi'nin en önemli kentlerinden biri olan Tarsus'ta 2007 yılında gerçekleştirilen kazılar sırasında bir köprüye ait anıtsal bir kemere ulaşılmıştır. Kemerin formu, kazıcıları tarafından "segment kemer" olarak tanımlanmış ve yapının MS 1. yüzyıla tarihlenmesi önerilmiştir. Ancak, köprünün özellikle memba tarafında yoğunlaşan girift yapılanmadan dolayı yapıya ait bazı bölümler gözden kaçırılmış ve gerek kemer formunun değerlendirilmesi gerekse de tarihlemesi eksik bulgulardan hareketle yapılmıştır. Dolayısıyla bu makalede, köprünün yeni tespit edilen özelliklerinden yola çıkılarak inşa tarihinin yeniden değerlendirmesi ve netleştirilmesi amaçlanmaktadır. Doğu-batı doğrultusunda uzanan köprüye mansap cephesinden bakıldığında anıtsal kemer, 5-6 sıra blok taştan oluşturulan ve yükseltilmiş olan düz ayaklar üzerine oturtulmuş gibi bir izlenim vermektedir. Memba cephesinde ise kemerin özellikle doğu tarafta kalan sınırlı bir bölümü görülmektedir. Bu cephede köprü kemerinin ayak üzerine oturtulmadığı ve ayaktan itibaren doğu yönde devam ettiği görülmektedir. Üstelik aynı cephede, kemer formunun hatalı değerlendirilmesine yol açan köprü ayağının kemer alnına ulaşmadan tonoz içinde sonlandığı takip edilebilmektedir. Dolayısıyla söz konusu ayakların, yapının tonoz içlerine sonraki bir evrede eklenmiş olabileceği düşünülebilir. Köprünün memba tarafında yeni tespit edilen özelliklerden dolayı öncelikle köprü kemerinin segment kemer değil üç merkezli kemer formunu yansıttığı anlaşılmaktadır. Dahası bu formun Roma Dönemi köprü mimarisinde kullanımı söz konusu değildir. Analojik değerlendirmeler sonucunda, bu formun en yakın benzerinin Rodos'ta olduğu anlaşılmaktadır. Rodos'taki tonozlu yapı bir köprüden ziyade bir drenaj kanalını örtmekte ve inşa tarihi için Hellenistik Dönem önerilmektedir. Bunun yanında Tarsus Köprüsü'nde diyagonal kemer taşlarının cephede demir kenetlerle bağlanmış olması ve yapı genelinde harç kullanılmamış olması da dikkate değer niteliklerdir. Tarsus Köprüsü'nün mimari özellikleri ve inşa tekniği hakkında da bazı tespitlerde bulunmak mümkün olmuş ve yapılan analizler sonucunda yapının sergilediği özelliklerin Hellenistik Dönem'e işaret ettiği sonucuna ulaşılmıştır. Elde edilen bulgulardan hareketle ele alınan köprünün inşa tarihinin belirlenebilmesi için Tarsus'un

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I would like to express my thanks to Prof. Dr. Murat Durukan for his valuable contribution and guidance as well as his encouragement on rediscussing the structure evaluated here.

Hellenistik Dönem tarihi irdelenmiştir. Böylece tarihlemenin sağlam kanıtlara dayandırılması amaçlanmıştır. Hellenistik Dönemde özellikle Seleukoslar tarafından bölgenin öteki kentleri ile birlikte Tarsus'ta da bazı politik düzenlemelere gidilmiştir. Gerek tarihsel bağlam gerekse de analojik değerlendirmeler ve ele alınan yapının sergilediği mimari özellikler; köprünün Hellenistik D önemde inşa edilmiş olabileceğine işaret etmektedir. Tarsus Köprüsü'nün sergilediği özellikler, tarihsel süreçle de ilişkilendirilmekte ve yapının inşa tarihi için MÖ 2. yüzyıl önerilmektedir.

Anahtar Kelimeler: Tarsus, Taşköprü, Segment Kemer, Üç Merkezli Kemer, Hellenistik Dönem, Seleukoslar.

ABSTRACT

In Tarsus, one of the most important cities of the Cilician Region, a monumental arch belonging to a bridge was found during an excavation carried out in 2007. The form of the arch was evaluated as a segmental arch by its excavators and the date of the structure was suggested as 1st century CE. On the other hand, because of the intricate structuring particularly on the upstream façade of the construction, some parts pertaining to the bridge were overlooked, and both the evaluation of the arch form and its dating were done based upon insufficient findings. Therefore, in this article, it is aimed to re-evaluate and clarify the construction date of the bridge based on the newly identified features. When viewed from the downstream façade of the bridge, which extends in the east-west direction, the monumental arch gives the impression of sitting on flat piers formed by 5-6 courses of stone blocks and raised. On the upstream façade, a restricted part of the arch, especially on the east side, can be seen. On this façade, it is observed that the bridge arch is not placed on a pier and continues in the east direction from the pier. Moreover, on the same façade, it it is obvious that the bridge pier, which causes an incorrect evaluation of the arch form, ends in the vault before reaching the archivolt. Therefore, it can be suggested that the piers in question may have been added to the vaults of the building in a later phase. Due to the newly detected features on the upstream façade of the bridge, it is understood that the bridge arch primarily reflects the three-centered arch form, not the segment arch. It is known that this form is not used in Roman bridge architecture. The result of analogical studies show that the most similar form stands in Rhodes. The vaulted structure in Rhodes covers a drainage channel rather than a bridge, and the Hellenistic period is suggested for the construction date. In addition, the remarkable features are that the diagonal arch stones of the Tarsus Bridge are connected with iron clamps and mortar is not used. As a result it has been possible to make some determinations in the context of architectural features and construction techniques of the Tarsus Bridge: It has been concluded that the features of the building point to the Hellenistic period. Furthermore it is aimed in this article to base the proposed dating on solid evidence and in order to determine the construction date of the bridge based on the findings, the history of the Hellenistic Period of Tarsus is examined. In the Hellenistic period, some political arrangements were made in Tarsus along with the other cities of the region, especially by the Seleucids. Evaluations for both the historical context and analogy as well as the architectural features of the structure in question confirms that the bridge may have built in the 2nd century BCE.

Keywords: Tarsus, Stone Bridge, Segmental Arch, Three-Centered Arch, Hellenistik Period, Seleucids.

I. Introduction

Beyond its international significance, one of the most critical routes of antiquity, which also served military purposes, passes through the Cilician Region. After crossing the Gülek Pass, which is called *Kilikia Pylai*, this road reaches Tarsus, one of the most important cities of the region and highly popular in both Hellenistic and Roman periods just as it was in the previous periods, and heads east through this city[1]. The eastern continuation of the said route which is named *pedias* is rich in streams. Here there are bridges built for military purposes, such as Adana-Taşköprü[2] and Misis Bridge[3], whose original construction pertains to the Early Imperial Roman period. This important route[4], whose significance is often emphasized in ancient literature, was deemed important by all the civilizations that controlled the region, and it seems that stone bridges were constructed at the points where this road met the rivers in order to ensure that the road continued uninterruptedly.

It is reported by the geographer Strabo that the Kydnos River passes through the middle of ancient Tarsus, which lies on a plain[5]. Procopius, on the other hand, states that the city was exposed to a great flood in the 6th century AD. In addition, this author also includes the information that the river bed was changed by the Emperor Iustinianus and the river was moved to the east of the city after the flood[6]. Modern Tarsus was built on the ancient city of Tarsus, which is known as the metropolis of the Cilician Region. The Tarsus Bridge, on the other hand, is located in the city center, on the old bed of Kydnos.

The Tarsus Bridge, the subject of this study, must have been primarily designed for inner-city transportation, as it is understood from its location in the center of Tarsus. Additionally, it can be thought that the continuance of the international route, whose importance was emphasized above, was also taken into consideration in the planning. In this regard, it can be suggested that the bridge may have provided a road connection via this significant route, which is of military and commercial importance, as well as playing an active role in the inner-city transportation.

The Tarsus Bridge was unearthed during the excavations carried out in the past years. During the excavations performed by the experts of the Tarsus Museum in the area where the bridge is located, the bridge arch was also discovered in the south of the Makam-ı Danyal Mosque along with structures of later periods. A single arch belonging to the structure, which was found by chance during these excavations, is observed. It is not known whether the structure extends in eastern or western direction, as this area is surrounded by the modern settlement.

During the excavations, the bottom section of the bridge vault was accepted as

1 Erzen 1940, 27; Starr 1963, 163-165;
2 A study, in which the architectural features and the construction history of Adana Taşköprü are rediscussed by me is being prepared for publication. Göçmen, in press.
3 A study, in which the architectural features and the historical process of the Misis bridge are rediscussed by us is being prepared for publication, see Göçmen – Durukan, in press.
4 Herodotos V. 52; Ksenophon II. 21; Arrianos II. 4. 3.
5 Strabon XIV. 5. 12.
6 Procop. V. 5. 14-20.

level and the foundations of the structure were reached at a depth of approximately 5.40 m. It is observed that neatly-cut rectangular large stone blocks exceeding 1.00 m in size were used in the construction of the structure. Both the size of the stones used in the construction and the width of the opening as well as the general architectural features of the structure create a monumental effect on the viewers.

The form of the arch, which constitutes the only span of the Tarsus Bridge, is defined by its excavators as "a segmental arch", and the use of this form is associated with Roman bridges[7]. In the publications issued after the excavation, the structure was dated to the 1st century CE in reference to the features it exhibits, as well as the historical context[8].

The Tarsus bridge, is also discussed by other researches. In the recent previous years, the remains of a street described as the *decumanus maximus* of Tarsus has been excavated till around the 'Cleopatra Gate' located southwest of Tarsus[9]. This street, with a southwest-northeast axis, is associated with Strabo's expressions, and it is stated that Tarsus had a regular city plan already during the Augustian-Tiberian period. Based on this determination, it is suggested that the bridge discussed here is part of the newly unearthed street and was in use during the Augustinian period[10].

The evaluation done by taking the present state of the well-preserved bridge arch into consideration renders it possible to put forth new observations and inferences. First of all, it must be remembered that the use of segmental arches in Roman bridge architecture was preferred only in a few examples[11], and that semicircular surbased arches were mainly used[12]. Additionally, the accuracy of the evaluation, which states that the arch of the Tarsus Bridge is a segmental one[13], is also a matter of debate.

Beyond the scope of the debate on the arch form, this article aims to clarify the construction date of the Tarsus Bridge based upon the architectural features of the structure. Accordingly, various architectural applications are observed on the structure, and clear chronological determinations are undertaken. Besides the architectural findings, the historical context is also examined, and thus the proposal for the dating of the structure can be built on solid basis.

7 Eser 2014, 19.
8 Yıldız 2008, 32; Eser 2014, 13; Alkaç 2016, 30.
9 Alkaç – Kaplan 2017, 89.
10 Alkaç and Kaplan took into account the architectural and archaeological data around the old river bed with the knowledge that the Kydnos River passed through the middle of the city by Strabo. Based on Strabo's death year 19 AD, they suggest that both the street remains unearthed near the Cleopatra Gate and the Tarsus Bridge were in use in 19 AD. For detailed information, see Alkaç – Kaplan 2017, 82- 87.
11 For the use of this form in the Alcantara Bridge in Spain, see O'Connor 1993, 109; Tyrrell 1911, 34- 35 and for the use of this form in the Limyra Kırkgöz Bridge, see O'Connor 1993, 126.
12 The arches whose rise is less than half of the span are described as semicircular surbased arches. For the use of this arch form in Roman bridges, see Gazzola1963b, 33; O'Connor 1993, 163- 164; Bayer 2012, 10; Sonavane 2014, 37.
13 Eser 2014, 19.

II. The Architectural Features of the Tarsus Bridge

The Tarsus Bridge, located on the old bed of the Kydnos River, which takes its source from the Taurus Mountains and flows into the Mediterranean, extends in the east-west axis. The upper part of the bridge vault, which was uncovered just south of the Makam-ı Danyal Mosque, was largely destroyed and the excavations of the building, which was filled with mud, were continued from this gap (fig. 1)[14]. Rectangular stone blocks made of local limestone were used in the construction of the bridge. The only arch of the structure that has been uncovered crosses a span of approximately 12.93 m[15]. The height of the arch was measured as 5.40 m based on the highest point of the vault and the width of the deck as 9.00 m. It is understood that the archivolt of the bridge in the south direction, on the downstream façade, is not fully preserved and the archivolt thickness has reached 1.10 m in its current state. It is a remarkable detail that mortar is not used between the large-sized blocks that make up the upper part of the vault and the archivolt. In addition, the inner parts of the building stones that make up the vault were attached to each other with iron clamps of approximately 18 cm length (fig. 2-3).

Some determinations can be made about the general appearance of the bridge from the limited area on the downstream front, where only the upper parts of the arch can be seen. On the aforesaid façade, the sections of the spandrel walls are completely limited by the walls of modern buildings. Therefore, it is not fully understood what kind of façade arrangement the building has. More precisely, it is not fully understood what kind of façade arrangement the building reflects, as the arch is limited to late period structures and modern structures at both the east and west ends (fig. 4). Moreover, the fact that the archivolt has been severely damaged in this area also causes uncertainty in the perception of the façade arrangement.

As the northern façade of the structure, in other words, the upstream façade, is bounded by different structures built in the later phases, it exhibits a mixed appearance in its present state. Additionally, the later period structures adjacent to the upstream façade almost entirely cover this façade. Therefore, the northern façade of the structure was not correctly studied by the experts who carried out the excavations on the bridge, and it was misevaluated accordingly due to lack of data. On this façade, it is possible to say that the structure is generally intertwined with the later period structures.

A very important detail attracts attention in this adverse condition concerning the upstream façade. In the eastern corner of this façade, a small part of the spandrel walls can be seen together with the archivolt. It is also visible from the upstream of the raised piers followed from the other side. Moreover, it is understood that the arch curve continues eastward from east pier on the upstream façade. The arch curve in question reveals that the opening was approximately 3.50 m wider. The same situation should be true for the western pier. Therefore, considering that the arch continues on both sides from the piers, the total arch span reaches 20.00 m. In addition, there is a

14 Yıldız 2008, 32.

15 The distance between the piers inside the vault, which caused the bridge to be defined as a segment arch, was measured as 12.93 m.

diffenerence of 35 cm depth between this element, which is considered as a pier in the east and the archivolt extending to the east. In other words, the archivolt and the aforesaid pier do not lie in the same level (fig. 5). This structuring must have been overlooked in previous studies.

Another vaulted structure built in the form of a pointed arch on the upstream façade leans against the archivolt along with the spandrel wall pertaining to the bridge, of which a small section can be seen. The vault of this structure extends along the north direction, parallel to the bridge, and rests against the partially visible spandrel wall of the bridge. This vault, which cuts the spandrel wall of the bridge and which is attributed to a later period, leans against another structure towards the west, and these later period structures cover the western section of the upstream façade of the bridge completely (fig.6-7).

Considering the arch of the well-preserved Tarsus Bridge, the evaluation allows to make some new findings and inferences. First of all, it should be remembered that the use of segment arches in the bridge architecture of the Roman period was preferred in only few examples[16]; predominantly, semicircular arches were used[17]. It is seen that the preserved archivolt on the upstream façade of the bridge were designed diagonally, not radially, unlike the examples of bridges from the Roman period[18]. This design creates a problem in terms of arch static, but it also allows a wider opening to be passed. These stones can also be evaluated as an indication that the arch of the building was not designed in a semicircular form[19] unlike Roman period bridge examples. Considering the arch span of the bridge, the bridge crossing a span of 20.00 m should have an arch height of approximately 10.00 m in order to reflect the semicircular form. However, the arch height of the structure in question is 5.40 m. In other words, in order to reflect the semicircular form, the arch needs to rise approximately 5.00 m higher, but this is not possible. The diagonally shaped archivolt stones also point to a shallow and wide arch. Therefore, according to these criteria, it becomes clear that the arch is not designed in a semicircular form.

The accuracy of considering the arch used in the Tarsus Bridge, which does not seem to reflect a semicircular design as a segment arch[20], is also a matter of debate. Based on the available data, the bridge arch should be either a “segment” arch as recommended[21] or a “three-centred arch” (fig. 8-9). While the segment arch is placed

16 For the use of this form on the Alcantara bridge in Spain, see O’Connor 1993, 109; for its use in the Limyra Kırkgöz Bridge, see O’Connor 1993, 126.

17 Arches whose height is less than half of the span through which they pass are described as semicircular arches. The ½ ratio is taken as a basis in the design of these arches. On the use of this arch form in Roman bridges, see Gazzola 1963b, 33; O’Connor 1993, 163- 164; Bayer 2012, 10; Sonavane 2014, 37.

18 The rustic arrangement that reminds the rough, undressed state of the stones, is also observed in bridges such as the Kozan bridge, whose construction is associated with the Early Imperial period, and the Orta Tozlu bridge, located a few kilometers east of Anazarbus. For detailed information on the Kozan Bridge, see Göçmen 2021, 137-147; for the Orta Tozlu Bridge, see Göçmen 2021, 132-137.

19 For the ½ ratio in Roman period bridges designed in semicircular form, see Gazzola1963b, 33; O’Connor 1993, 163-164; Bayer 2012, 10; Sonavane 2014, 37; Alcayde et al 2019, 1-3.

20 Eser 2014, 19.

21 Yıldız 2008, 32; Eser 2014, 13.

on upright and raised piers, the archivolt continues up to the floor in the three-centered arch. It is understood that the arch form was defined as a segment arch based on the piers that were added to the structure later and possibly intended to strengthen it. However, on the upstream façade, the archivolt deepens towards the east from the pier. Moreover, both piers differ from the building in general in terms of both stone size and workmanship. Considering the available data, it is concluded that these elements were added to the structure at a later stage and that the arch form should be defined as a three-centered arch, not a segment.

In short, in the form of a segment arch, the arch should be placed on upright piers. This is not the case with the Tarsus Bridge. For this reason, the arch form used in the building is defined as a "three-centered arch". Moreover, the use of diagonal stones in the archivolt of the building and the arch design point to pre-Roman times because both this form and the diagonal archivolt stones were not used in the Roman period. On the other hand, a three-centered arch was used in a bridge called "Ponticello di Rodi" which was dated to Hellenistic period[22]. Therefore, the fractures in the upper part of the vault of the Tarsus Bridge and the arch angle continuing towards the east confirm that the three-centered arch was preferred in this bridge, as in the Rhodes example which will be handled here below.

The evaluation based on these observations reveals that the arch form of the structure is not a "segment arch" but a "three-centered arch". This form consists of two curves divided from the center points when compared to the semicircular arch. This form is generally described by three separate centers which forms the curvature of the arch. In fact, the rib is noncontinuous unlike semicircular arches, due to the break at the apex of the arch[23]. Therefore, it exhibits a much broader appearance when compared to the semicircular arch. Interestingly, three-centered arches were not used in Roman bridges. The arch forms prevalently used in the Roman bridges: semicircular barrel vault[24], circular arch[25], and segmental arch[26] -which is represented by few examples-. Consequently, the fact that the Tarsus Bridge was constructed using a three-centered arch indicates a significant chronological difference.

It appears that the reason for the misinterpretation of the arch form of the structure in previous studies is that the piers discussed above were thought to be original. In this regard, the evaluation and dating based upon the piers are incorrect. In fact, viewed from the southern façade, the bridge arch has been interpreted as seated in raised piers and erroneously defined as a "segmental arch". However, as is seen in the view from the upstream façade, these piers were attached to the vault in later phases.

In addition to the discussions on the arch form, it is understood that stone blocks reflecting the *opus quadratum* technique[27], varying in the range of 0.56 m x 1.60 m,

22 Boyd 1978, 91; Galliazzo 1995, 36.
23 About the three-centered arch, see Boyd 1978, 90 and footnote 30; Sonavane 2014, 37.
24 Gazzola1963b, 33; O'Connor 1993, 163-164; Bayer 2012, 10; Sonavane 2014, 37.
25 O'Connor 1993, 25.
26 O'Connor 1993, 109, 126.
27 On the opus quadratum technique, which was also used in Roman bridges, see O'Connor 1993, 166; Staccioli 2003, 111; Gençer-Turan, 2017: 192.

0.30 m x 0.90 m and 0.30 m x 0.96 m on the bridge façade, were used. In addition, it is seen that the archivolt stones, whose heights vary between 0.98 m and 1.20 m, are connected to each other with 18 cm long iron clamps, just like in the inner parts of the vault. The early use of "U or P-type" clamps on the archivolt of the bridge is associated with the Hellenistic period[28]. In the Messene Asklepion Stoa, which was built in the first half of the 2nd century BCE, the use of mortarless construction, which is a characteristic of the period architecture, becomes evident and it is understood that the building stones were fastened with iron clamps[29]. It can be thought that the dowel holes in the vaulted passage of the Sikyon Theater, whose early phase is associated with the year 251 BC, are evident at the junction of the archivolt stones, may be associated with the use of clamps[30].

However, in Roman period, P-type clamps were used in the construction of many buildings as well as bridges[31]. Moreover, the use of clamps was common in important centers in Asia Minor during this period. The use of clamps is also associated with repairs[32]. However, the iron clamps seen on the archivolt of the Tarsus Bridge do not create a perception of repair because there is no deterioration of axle in the arch static. Moreover, iron clamps reflecting the same qualities and dimensions were also used in the vault of the structure. Therefore, the use of clamps in the aforesaid structure cannot be associated with the repair. Possibly, the diagonal design of the blocks used on the archivolt and the concern about the static of the bridge led to the use of iron clamps on the archivolt and in the vault. This detail is important for the dating because while the iron clamps are applied in the interior parts of the structure in Roman bridges, the use of clamps on the façade is out of question.

Another important aspect is that the bridge deck extends directly from the upper part of the vault. This is also confirmed by the cart ruts that can be detected at two different points, which are at the south and north of the 9.00 m wide vault. It is presumed that cart ruts, of about 2.00-2.50 m in width, were formed as a result of long-term use (fig. 10-11). In the east and west of the area where the ruts are evident, these traces do not continue because the deck filling was removed. There is no trace of the mortar filling known from Roman period examples on the deck[33] and it is evident that the vault stones exhibit a clean surface in the hollow areas. The hollow areas to the east and west of the upper part of the vault should have been raised with a fill made of plate stones in order to form a plane with the upper of the vault. If mortar filling

28 It is known that iron clamps associated with Greek architecture have subtypes categorized as dovetail, Z, double T and U or P. Among these, the use of the first three types became evident from the 6th century BC, while the use of "U or P-type" clamps became widespread after the 4th century BC, see Çördük 2006, 25.

29 Yoshitake 2013, 693-695.

30 Boyd 1978, 85 and footnote 8-9.

31 Galliazzo 1995, 243-244; Adam 1994, 96-100.

32 In settlements such as Klaros, Ephesos and Nysa, P-type clamps are used in the repair of structures. However, it is very clear that this use is for repair purposes. On the use of clamps in Asia Minor, see Ismaelle 2013, 275-277.

33 In Roman bridges, the inner parts of the spandrel walls are supported with opus caementicium filling, so that the structure is strengthened as well as obtaining a flat deck. On this subject, see O'Connor 1993, 163- 164, 166.

would have been used on the deck of the bridge, the remains of the mortar layer would definitely be seen in the hollow areas where the cart ruts have disappeared. However, at present, these stones that form the vault have a clean surface and there is absolutely no data on the mortar layer.

The insistence on crossing a wide span of 20.00 m in the plain geography can be explained by the fact that the use of mortar was not known at the period the bridge was built. If this technology had been known at the period the bridge was built, a more reasonable option such as constructing a multi-arched bridge using radial stones and piers at half the distance would be prefered. At this point, the most important criterion would be the use of mortar in order to be able to build piers in water. The reason why this method was not applied to the Tarsus Bridge and why it was insisted on crossing a span of 20.00 meters in one go must lie in the lack of knowlegde considering the use of mortar and the lack of ability to build piers in the middle.

III. The History of Arches and Vaults

It is known that bridges were constructed using different techniques and forms before the true arch was used in Greek world. The construction of these bridges, which do not reflect the true arch, is represented by numerous examples in both Mesopotamian and Greek architectures[34].

It has been recorded by ancient writers that there were early period structures in which arches were used. In this context, Strabo's statements as to the use of true arches and vaults in the Hanging Gardens of Babylon are worthy to note[35]. Due to the presence of the true arch and vault forms in the Ishtar Gate and the Hanging Gardens of Babylon, it is accepted that they were known and used in Mesopotamia as of the 4th millennium BCE[36].

The true arch and vault are thought to have been used already before the time period of Alexander in the Macedonian tombs at Vergina[37]. Besides, according to another view, it is suspected that this practice was brought to Greek territories by the successors of Alexander[38]. As a result, it is understood that the use of arches and vaults was widespread in the Hellenistic period and is illustrated by many examples.

A bridge on Rhodes, named “Ponticello di Rodi”, which is considered to be built as a connection road as well as a drainage canal, provides significant information on the application of true arches and vaults during the Hellenistic period. It is known that features such as radially arranged arch stones and decks extending over the arch

34 For early period Egyptian bridges built using the method of “false arch” or “corbel arch”, see Briegleb 1971, 256; For the use of such arches in Hittite period, see Galliazzo 1995: 9; Regarding the use of such arches in the Assyrian and Neo-Babylonian periods, see Briegleb 1971, 259; For the use of such arches in the Greek architecture, see Briegleb 1971, 256-257; Galliazzo 1995, 23, 38; O’Connor 2010, 2; Scholl 2011, 58-59; Slawomir – Tsu Tuan 2017, 239-244.
35 Strabon XVI. 1. 5.
36 Boyd 1978, 89.
37 Dodge 1984, 216, 251-252
38 Sonavane 2014, 11-12.

faces[39] were used during the Roman period[40] as well. However, unlike the Roman examples, the arch of the Rhodes Bridge, which is dated to Hellenistic period, displays a three-centered arch design (fig. 12)[41].

Another example belongs to a structure in Samothrace, located under a *Propylon* that was designed during the reign of Ptolemy II[42]. The structure, constructed using a radial arch, forms a canal that vaults over a stream. The said canal is dated to the 3rd century BCE, based upon the inscription recovered from the area[43].

Another example is the stone bridge (true arch?) that is thought to connect the Island of Leucas to the mainland of Akarnania. Although it is not exactly known how the spans of the bridge, which was preserved at the foundation level, were covered, it is suggested that it might have been an arched superstructure. Based upon the history of the aforementioned settlements as well as the information provided by ancient sources, this alleged bridge is dated to the end of the 3rd century BCE[44].

A further example, which was situated on the Orontes River in Antioch, is a bridge (true arch) suggested to have had two arches. It is thought that this bridge, which has not survived to the present day, was built in the Late Hellenistic period, in other words, the 1st century BCE[45].

Two arches, one each on the fortification walls of Oiniadai and Palairos, both located in northwestern Greece, display a rustic look due to the irregular masonry and the difference in size and shape of the stones that form the arch face. Both arches, based upon historical process, are dated to the end of the 3rd century BCE[46].

An arched gate situated between Corinth and its port facilities, and the barrel-vaulted reservoirs found at Sikyon, which are both associated with the activities of Demetrius I Poliorcetes, are attributed to the year 303 BCE. It is suggested that one of the barrel-vaulted passageways of the theater, whose original construction is dated to 251 BCE, also found at Sikyon, and a passageway that leads to the *adyton* of the Temple of Apollo at Didyma date back to the second half of the 3rd century BCE, namely the Hellenistic period[47]. In addition, the theater cistern in Delos, which is dated to Hellenistic period and reflects an arched structure, is another remarkable example[48].

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39 Galliazzo 1995, 36.
40 O'Connor 1993, 66.
41 Boyd 1978, pic. 6; Galliazzo 1995, 36, pic. 20.
42 Ptolemy II Philadelphus, a successor of Alexander, was the ruler of the Ptolemaic dynasty between 283 and 246 BCE.
43 Another bridge, whose superstructure layout is unknown, has also been discovered in this area. It is thought that this bridge and the above-mentioned canal are of the same period, and it is suggested that both are constructed between 280 and 279 BCE. For detailed information, see Boyd 1971, 86; Briegleb 1971, 259; Galliazzo 1995, 38.
44 Strabon I.3.18 and X.2.8; Fiedler – Hermanns 2011, 50-51.
45 Galliazzo 1995, 38-39. Also located on the Orontes River in Antioch, another, four-arched bridge is dated to the period of Diocletian. See O'Connor 1993, 127.
46 Boyd 1978, 91-94, pic. 8-10.
47 Boyd 1978, 83-86.
48 Dodge 1984, 219, 228.

A further important example, of which the construction began in the Hellenistic period and continued in the Roman period, is the Temple of Apollo at Klaros: An arched structure is constructed in the *adyton* of the temple. Although it is not known exactly when this section was built, it is claimed that it reflects its current appearance in 18 AD through the expressions of Tacitus[49].

The practices of the true arch and vault was known in Hellenistic period in the Cilician Region as well. At Korykion Antron, a part of the sinkhole wall of the big sinkhole is passed through an arch, and constructions in this area are generally dated to the 2nd century BCE[50]. Additionally, it is seen that the arch was also used on the front façade of the Temple of Hermes at Yapılıkaya, and it is suggested to be constructed during the 2nd century BCE[51].

The arch and vault examples, with the exception of Ponticello di Rodi, do not formally resemble the Tarsus Bridge, although they are associated with the Hellenistic period. At this point, it is important to know that there are various variants of the true arch and vault application in the Greek world in terms of form[52]. In other words, Greeks, who had just stumbled upon the true arch, used arches and vaults designed in various forms in the structures they built.

IV. Evaluation of the Tarsus Bridge

Although there are different opinions about the early use of arches and vaulted covers, it is concluded that the origin of these architectural elements should be sought in Mesopotamia. At this point, although it is suggested that the arch and vault were in use in Greek territories before Alexander, it is accepted that the Greeks especially Alexander's successors met these architectural elements in the context of Alexander's eastern expeditions and transported them. Numerous examples discussed here prove that true arches and vault were known and applied in the Hellenistic period.

Generally, the Hellenistic precursors of the arch form are evident on structures such as bridges, drainage canals, and fortification walls. The most noteworthy of these examples is the bridge called "*Ponticello di Rodi*" which is located on Rhodes and exhibits the three-centered arch design. This bridge is associated with the Hellenistic period, and is generally attributed to Hellenistic period[53]. With regard to the Tarsus Bridge discussed here, what renders the structure on Rhodes special is the close similarity between the arch forms of both structures. The Tarsus Bridge, like the example on Rhodes, also displays the three-centered arch design.

Another important feature of the Tarsus Bridge is that no mortar was used between the joints and on the upper part of the vault. In Roman period, the use of mortar was common, particularly in water- related structures. In most of the period bridges,

49 Şahin 1998, 40.
50 Durukan 2019, 58-59; 48-49.
51 Durukan 2011, 145, pic. 8.
52 Dodge 1984, 216.
53 Boyd 1978, 91; Galliazzo 1995, 36.

mortar is applied on the piers in contact with the water as well as on the deck filling[54]. In this context, the earliest use of mortar in the region was found in the temple located in Elaiussa Sebaste and was dated to the end of the 1st century BCE[55]. Based on this information, it can be deduced that the use of mortar was known and practiced in the region at least since the end of the 1st century BCE.

In Greek architecture, it is stated that depending on the initiative of the architect, the structures are sometimes supported by clamps, and sometimes such apparatuses are not included as the balance and static of the arch is understood[56]. In this regard, it is reported that the bridge connecting Leukas and the Akarnanian mainland was built without the use of mortar[57].

Regarding mortarless construction, another important issue that certainly needs to be emphasized in the context of Hellenistic architecture is the use of clamps to ensure the safety of the structure or the arch. As accentuated before, similar to the Tarsus Bridge there are findings showing the use of P-type clamps in the Stoa of the Asklepieion at Messene[58], the vaulted passageway of Sikyon[59] and the Temple of Artemis of Magnesia[60], which are dated to Hellenistic period.

In light of the features and similarities discussed here, the characteristics of the Tarsus Bridge in general point to the Hellenistic period. Thus, following the analysis of the arched and vaulted structures built in the said period, it is important to examine the historical context of Tarsus as well.

The earliest data on the Hellenistic period of Tarsus date back to the Alexander period. According to ancient literature[61], it is told that Alexander arrived in Tarsus, which was then under Persian control, after passing through the *Kilikia Pylai* (Cilician Gates), it is also mentioned that after the area was secured he had to camp in Tarsus for a long time due to some compelling circumstances. After the death of Alexander, Cilicia stands out as a region of conflict between the Seleucids and the Ptolemies throughout the 3rd century BCE[62]. Yet, it is known that Cilicia *Pedias* fell under the control of the Seleucids, and that Tarsus was renamed in the 3rd century BCE[63]. Following the Treaty of Apameia signed in 188 BCE, Cape Sarpedon was defined to be the western border of the Seleucid Kingdom. Significant developments took place in Cilicia and in the city of Tarsus during the reign of Antiochus IV Epiphanes, who ascended the throne of Seleucid in 175 BC[64]. Within this period, while other cities of the region were being renamed after the dynasty, Tarsus was affected by this change as

54 O'Connor 1993, 163-164.
55 Kaplan 2009, 23-32; Durukan 2011, 150, 155.
56 Boyd 1978, 96.
57 Fiedler – Hermanns 2011, 50.
58 For dovetail, "L", and rectengular clamps, also see Yoshitake 2013, 693-695.
59 Boyd 1978, 85, footnote 8-9.
60 Demirtaş 2006, 56-59.
61 Arrianos II. 4. 2-11.
62 Tempesta 2005, 59.
63 Regarding the mention of the city as "Antioch on the Kydnos" in a proxeny list, recovered from Delphi, dating to the 3rd century BCE, see Cohen 1995, 358.
64 Tempesta 2005, 60-61.

well. It has been verified by coin legends and transmissions that Tarsus was named as "Antioch on the Kydnos" also during this time[65]. It is known that the renamed Tarsus, besides being the administrative center of Cilicia, was the site of the royal mint, and issued coins bearing the legend of ΑΝΤΙΟΧΕΩΝ ΤΩΝ ΠΡΟΣ ΠΥΡΑΜΩΙ[66].

Renaming Tarsus as Antioch, it can be considered as a reflection of the effort of Antiochus IV Epiphanes (175-164 BC) to hellenize the regional settlements. However, the fundamental condition to assimilate a society or community is directly related to the investments the victorious central government makes in that region, that is, architectural activities. Parallel reflections of this situation can also be seen in the Olbian Region of the same period that is situated in the eastern part of Rough Cilicia[67].

V. Conclusion

The discussed Tarsus Bridge, which was situated at the city center has several uncommon architectural features such as the use of three-centered arches, the mortarless construction and relatedly iron clamps, the rustic stone masonry on the façades as well as the use of large-sized stone blocks throughout the structures.

The first feature mentioned above, the three-centered arch, is very rarely seen. Although this makes it difficult to evaluate the structure discussed here *analogically*, the Rhodes Bridge, which is dated to the Hellenistic period, bears a close resemblance. As such, it removes uncertainties about the Tarsus Bridge in this regard.

The assessment that mortar was not used in the structures, one of which was a bridge, attributed to the Hellenistic period also gives an idea on the possible period in which the Tarsus Bridge was built.

In addition, the "U or P- type" clamps used on the bridge's archivolt that are situated on the eastern part of the upstream façade are also known from other arched structures built in the Hellenistic period. Moreover, the fact that this form of iron clamp had been in use since the 4th century BCE helps to give a general date to the structure. The use of stone blocks up to 1.20 m in size in the construction of the bridge is similar to the known use of large-sized stones in Hellenistic structures.

In conclusion, it can be verified that the true arch was used in bridges, canals, fortification gates and public buildings during the Hellenistic period, and a wide variety of arch forms were applied. In light of the evaluations made on the aforesaid examples, it is understood that the arch form was introduced to Greek architecture from its origin, Mesopotamia. This influence, one of the many results of Alexander's eastern campaign, seems to be brought by the Alexander's successors. In the evaluation based upon historical process, it is seen that, during the 3rd century BCE, there was a strong Seleucid control over Tarsus, in which the discussed bridge was located. However, in line with the changing political circumstances, significant

65 Hild – Hellenkemper 1990, 428; Von Aulock 1963, 232-233.
66 Tempesta 2005, 62-63.
67 On the architecture of Hellenistic period in the Olba Region, see Durukan 2004, 45-51; Durukan 2011, 138-142.

events such as Tarsus becoming an administrative center between 175-164 BCE and housing a royal mint are the most unequivocal indication of the importance given to this settlement. At the core of all this, also in consideration of the shrinking Seleucid borders, lies the Seleucid King Antiochus IV Epiphanes's desire to strengthen his hold on the remaining lands. He had accelerated the Hellenization process throughout the country, including Tarsus. Therefore, in Tarsus, which he named as "Antioch on the Kydnos", he must have made attempts to develop the area, bringing the application of arches and vaults, which were commonly used in Mesopotamia under his sovereignty, to Tarsus. The most likely date to be proposed for the construction of the Tarsus Bridge, which displays Hellenistic features in this regard, is the period of Antiochus IV Epiphanes. The architectural features of the structure, the analogical evaluations, and the historical process all add weight to the possibility that the Tarsus Bridge was built in the first half of the 2nd century BCE.

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Fig. 1 The Top View of the Tarsus Bridge (Photo: İlkay Göçmen).

Fig. 2-3 General View of the Downstream Façade of the Bridge and the Top View of the Vault (Photo: İlkay Göçmen).

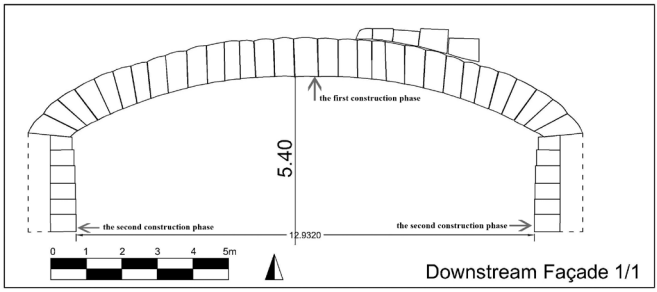

Fig. 4 Front View Drawing of Downstream Façade (Drawing: İlkay Göçmen).

Fig. 5 Inside View of the Vault from the Upstream Side (Photo: İlkay Göçmen).

Fig. 6 Archivolt and the Spandrel Wall of the Upstream Façade (Photo: İlkay Göçmen).

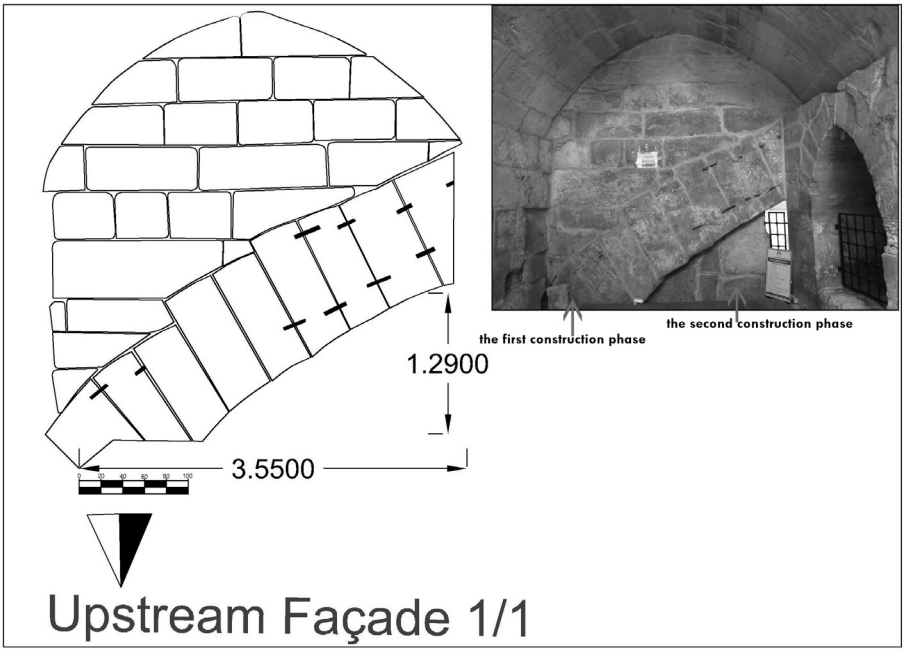

Fig. 7 Drawing of the Upstream Façade (Drawing: İlkay Göçmen).

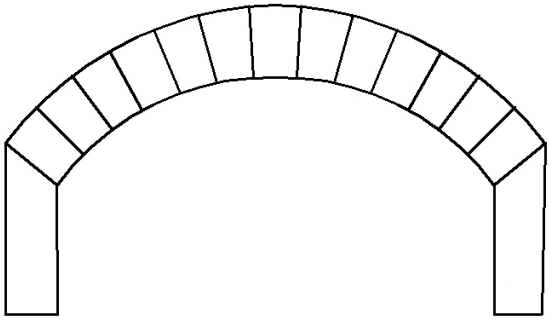

Fig. 8 Segmental Arch (Drawing: İlkay Göçmen).

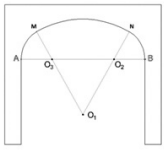

Fig. 9 Design of the Three- Centered Arch (Alcayde et al. 2019).

Fig. 10-11 Detail of the Cart Ruts in the Deck of the Bridge (Photo: İlkay Göçmen).

Fig. 10-11 Rhodes Bridge (Boyd 1978, Pic. 6).