

ORIENTALIA LOVANIENSIA
ANALECTA
————— 183 —————

EGYPT AND SYRIA
IN THE FATIMID, AYYUBID
AND MAMLUK ERAS

VI

Proceedings of the 14th and 15th International Colloquium organized at
the Katholieke Universiteit Leuven in
May 2005 and May 2006

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(eds.)



UITGEVERIJ PEETERS
LEUVEN – PARIS – WALPOLE, MA
2010

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MEDIEVAL BRIDGES OF PALESTINE

The study of medieval bridges in general, and medieval Islamic bridges in particular, is a subject, which has received very little attention compared with the detailed study of other classes of monument. This is surprising for two reasons, firstly a large proportion of medieval bridges in both Britain and the Middle East are still in use and secondly the majority of bridges were constructed as state enterprises and as such they are major public structures.

There are many reasons for this scholarly neglect although a few significant factors predominate, these are:

- 1) the conservative nature of bridge design which makes them difficult to date,
- 2) they are sparsely decorated and
- 3) there are practical difficulties in recording bridge structures particularly if they are still in use.

These three factors are all indicative of the general feeling that bridges are works of civil engineering rather than architecture and that they therefore tell us little about the society which produced them. In this short paper I hope to demonstrate the contrary – in other words that bridges can tell us a lot about the society that produced them and in particular about the priorities of communication and the level of technology they were able to employ.

Before looking at the medieval bridges of Palestine it is worth briefly discussing the origins and development of bridge technology in the Middle East and Europe¹. The first observation is that although bridges are generally considered to be an innovation of the Roman period there is considerable evidence for the construction of major bridges before this time. For example, Caesar noted a pre-existing major bridge crossing the Thames downstream from the present site of London², and there are

¹ For discussions of Medieval European bridges see N. Brooks, "Medieval European Bridges: A window onto changing concepts of state power", in *Communities and Warfare 700-1400*, ed. N. Brooks (London – Rio Grande, 2000), pp. 1-31, first published in *Journal of the Haskins Society*, 7 (1997 for 1995): 11-29. See also M. Cook, *Medieval Bridges* (Princes Risborough, 1998).

² C. O'Connor, *Roman Bridges* (Cambridge, 1993), p. 141.

many examples of presumably wooden bridges in pre-Roman Gaul. If we look at the eastern Mediterranean where written evidence survives we find an account of a timber bridge linking the island of Eubia/Evia with mainland Greece in the fifth century B.C.³ Further east in Mesopotamia we find the remains of an aqueduct bridge built by the Assyrian ruler Sennacharib in 690 B.C. The bridge is 280 metres long and is carried on five corbelled arches formed by large flat stone laid on horizontal beds shaped and brought forward progressively to form narrow pointed openings⁴.

The evidence from these early bridges shows that bridge technology pre-dated the Roman period by several centuries. However it is notable that none of these early bridges incorporated true arches. It is the achievement of the Romans that they employed arches and vaults in bridge construction on such a wide scale that many examples are still standing and in use. As a result of this, the study of ancient bridges and bridge technology is still dominated by the Roman model.

In the following discussion I will refer to bridges and their components by the terms set out in Figure 1 derived from O'Connor's work on Roman Bridges⁵. I will use these terms to provide structural analysis of medieval bridges in Palestine to help understand how they were built and how they function as structures (see Figure 1). The benefits of structural analysis are that it enables objective comparisons between bridges built in different regions and cultures at different times. A wide variety of structural elements can be measured and compared. In this paper I will concentrate on two ratios: 1) the ratio of arch span to rib thickness, and 2) the ratio of pier width to clear opening.

- 1) The ratio of arch span to rib thickness is the most important factor in building an arch. For most bridges (Roman and Medieval) the ratio was 1/10 of the span although in bridges with a larger span (i.e. over 15 metres) this could be reduced to a minimum of 1/20th of the span.
- 2) The ratio of pier width to clear opening- evidently bridge piers had to be wide enough to accommodate the thickness of at least two arch ribs although they frequently exceeded this. The limit on the maximum width of the pier was its effect on the flow of water — the

³ Brooks, "Medieval European Bridges", pp. 13-14 and fig. 7.

⁴ T. Jacobsen & S. Lloyd, *Sennacharib's Aqueduct at Jerwan* [Oriental Institute Publications, volume XXIV] (University of Chicago Press, 1935).

⁵ O'Connor, *Roman Bridges*, p. 164.

greater the width of the pier in proportion to the span (clear opening) the greater the water velocity, which would either undermine the foundations of the piers or the abutments.

A typical ratio in Roman bridges is about 1/3 of the span with a maximum of 1/2 or 50% and a minimum of 1/5 of the span. By way of comparison most modern bridges would be well under 1/5th.

BRIDGES IN THE MEDIEVAL ISLAMIC WORLD

With this historical and technological background we can now focus on the bridges of the medieval Middle East. In Arabic two words are used for bridge — *jisr* and *qaṇṭara*⁶. The term *jisr* was generally used to refer to a bridge of boats or a pontoon bridge although we find many examples of fixed bridges referred to by this term. The word *qaṇṭara* on the other hand refers specifically to an arch (bridge) of brick or stone. In Iraq and Egypt where the geography is dominated by major navigable rivers the distinction between *qaṇṭara* and *jisr* is more pronounced than Syria/Palestine where rivers and bridges are smaller both in number and size. As in the Roman period the greatest number of bridges in the region during the medieval times can be found in Anatolia/Turkey where there are a relatively large number of rivers crossed by major East-West routes. A number of famous medieval bridges survive in Turkey including the Malabadi bridge west of Diyarbakır (built circa 1150), which has a single main arch with a span of 38.6 metres⁷ and the Keşik bridge to the west of Sivas⁸, which is built on a series of nineteen arches with a combined span of 326 metres.

In Iraq and Egypt the principal bridges crossing the navigable rivers were generally wooden floating (pontoon) bridges, which could cope both with the major fluctuations in the water level, width of the channel and sometimes even the course of the river. In these countries masonry (stone or brick) structures were confined to lesser waterways such as canals and tributaries. For example the Harba bridge near Samarra in Iraq crosses a now dry river bed and is built of fired bricks instead of stone and decorated on both sides by a monumental epigraphic frieze proclaiming the names and the titles of the late ʿAbbasid ruler al-Mustansir who ruled in

⁶ “*Djīsr*”, in *EP*, II: 555; M. Streck, “*Qanṭara*”, in *EP*, IV: 555-6.

⁷ G. Tunç, *Taş Köprülerimiz* (Ankara, 1978), p. 130, no. 59.

⁸ *Ibid.*, p. 192 39.115 nos. 245, 41, 138.

the late twelfth century. Next to the bridge are the remains of a large *khān* or caravanserai also built during the reign of al-Mustanşir⁹. From a structural point of view this bridge is interesting for the excessive thickness of the piers which have a width more than 1/2 / 50% of the span of the arches. This may explain the excessive silting around the bridge and the eventual shift of the Tigris bed to a more easterly course (the narrow floodways have done little to reduce this problem). The other notable architectural features of the Harba Bridge are the use of the four-centre point arch (not used in Europe until the most medieval period) and the high walls of the carriageway which provide an extended area for the inscription panel.

In Egypt probably the most famous extant medieval bridge is the Jisr Abū Manajja near the village of Shubra in the Nile Delta. The bridge comprises six stone arches with a flat deck or roadway above and was built in the year 665/1266-7. The decoration consists of a series of large raised circular discs (blazons) decorated with epigraphic designs set within the spandrels as well as longer inscriptions along the parapet and a series of carved stone lions characteristic of Sultan Baybars¹⁰.

Within Syria a few major medieval bridges have survived including the Jisr al-Shughūr and Jisr al-Muzayrib. Jisr al-Shughūr is of considerable antiquity and a settlement of the same name has grown up around the bridge, which in its earliest stone form seems to have been a Roman construction. However in its current form Jisr al-Shughūr is substantially a medieval construction, as indicated by a semi-legible Mamluk inscription built into the parapet¹¹. The bridge at Muzayrib is a three-arched construction with no inscription, however a lion built into the structure indicates that it may be associated with a series of bridges built by the Mamluk Sultan Baybars.

BRIDGES IN MEDIEVAL PALESTINE

The majority of rivers in Palestine, with the notable exception of the Jordan River, either flow east-west from the highlands towards the Mediterranean or eastwards from the highlands into the Jordan. As the rivers get closer to the coast they tend to become wider and more

⁹ T. al-Janabi, *Studies in Medieval Iraqi Architecture* (Baghdad, 1983), p. 49.

¹⁰ K.A.C. Creswell, *Muslim Architecture of Egypt*, volumes I-II (Oxford, 1952-59), II: 150-54, plate 46.

¹¹ J. Sourdél-Thoumine, "Djīsr al-Shughūr", in *EP*, II: 556.

difficult to cross whereas in the mountains and at the foot of the mountains they are narrower and easier to cross. The optimal location for a north-south road is at the base of the mountains where the terrain is not too precipitous and the rivers not too wide. Figure 2 shows a distribution of known medieval bridges in Palestine for which we have some archaeological evidence whilst Table 1 and Table 2 give a summary of the attributes of these structures. This list is almost certainly not complete and should be regarded as representative rather than exhaustive¹².

The best-known medieval bridge in Palestine, Jisr Banāt Ya'qūb¹³ (Fig. 2, No. 1) has unfortunately not survived, having been destroyed by Jewish Colonists during the draining of Lake Huleh in 1934. Although no plan or measurements of the bridge were made before its destruction we do have a detailed account of the structure made by Captain K.A.C. Creswell in 1919 immediately after the First World War. His description is as follows:

'A bridge of four arches, of which the first commencing from the W. end is of good masonry, the 2nd has been blown up, the 3rd resembles the first, and the fourth of wider span is braced from side to side by two tie bars with "S" ends and must be quite modern. The masonry of the 1st and 3rd arches is of fair sized blocks, many of which have rusticated centres and drafted edges. The stone has taken a pale golden-brown tint. The arches have a median joint. Between the first arch and the W. bank there are irregularities in the masonry, but elsewhere it appears to be uniform. The masonry, of fine large blocks, of the 1st arch is not carried right through, the lining of the tunnel being of smaller stones. There are two "V" shaped piers on the N. side, but where the third would be there is a long spit of land rendering a third less necessary. That part of the bridge above the 4th arch is narrower than the last. The parapet is modern, and is built of small blocks of basalt.'

There are two points of particular interest in this description. The first is that the arch ribs are made of voussoirs/cut stone but the interior vaults are made of smaller stones. The second point is that the fourth arch was added later in 1904, perhaps indicating that the ratio of pier thickness to arch span was too low.

¹² Fuller descriptions of these bridges and bibliographies can be found in A.D. Petersen, *Gazetteer of Building in Muslim Palestine Part 1* (Oxford, 2001).

¹³ R.D. Pringle, *Secular Buildings of the Crusader Kingdom of Jerusalem. An Archaeological Gazetteer* (Cambridge, 1997), p. 85, no. 174; Sourdel-Thoumine, "Djīsr al-Shuḡhr", p. 555; C.R. Conder & H.H. Kitchener, *The Survey of Western Palestine. Memoirs of Topography, Orography, Hydrography and Archaeology*, eds. E.H. Palmer & W. Besant, volumes I-III (London, 1881-83), I: 206-7.

The second bridge, Umm al-Qanāṭir¹⁴ (Fig. 2, No. 2) is much less well known and like Jisr Banāt Ya'qūb it was destroyed in the early twentieth century- this time by British engineers who believed that the piers of the bridge obstructed the flow of water and caused the waters 'to overflow the low lying banks... thus becoming a breeding ground for mosquitoes, causing malaria in these neighbourhoods'. A glance at the plan of the bridge made by Lee Warner of the Department of Antiquities of Palestine indicates how much the water flow was constricted by the piers. The plan and section of the bridge also indicates that it probably functioned as an aqueduct a) because of the level height of the piers and b) because of the close spacing of the piers. This hypothesis is strengthened by the traditional name of the structure *qanāṭir* (aqueduct). This raises the possibility that there was another bridge in the vicinity, as al-Muqadassī refers to a fine bridge at the bottom of Lake Tiberias. If so this may have been a pontoon bridge.

The third bridge Jisr al-Majāmi' is located 200 metres south of the confluence of the Jordan and Yarmouk rivers¹⁵. Three bridges cross the river at this point, the medieval bridge, a rail bridge and a modern road bridge. As the river forms part of the border between modern Israel and Jordan, there is restricted access to the site. The only accessible drawing of the bridge is a sketch made in 1942, which clearly shows that there are at least two major phases of construction. The lower level may well be of Roman origin though the upper part with its pointed arches is clearly of a later, probably medieval, date. We know of at least two repairs to the bridge in medieval times, one by Usāma al-Ḥalabī during the reign of Ṣalāḥ al-Dīn and another by Jamāl al-Dīn in 664/1266-7. This is also supported by the architecture of the bridge, which differs significantly from the Mamluk bridges of Jisr Banāt Ya'qūb, Yibna and Jindas, which utilize small stones in the vault of the arches, whereas this bridge has voussoirs throughout the vault.

¹⁴ H.V. Guérin, *Description géographique, historique et archéologique de la Palestine; Galilée*, volumes I-II (Paris, 1880; repr. Amsterdam, 1969), I: 282; G. Le Strange, *Palestine Under the Muslims. A Description of Syria and the Holy Land from AD 650-1500* (London, 1890), pp. 52, 335; Shams al-Dīn Abū 'Abd Allāh Muqaddasī, *Descriptio imperii moslemici (Kitāb aḥsan al-taqāsīm fī ma'rifat al-aqālīm)*, ed. M. de Goeje (Leiden, 1877, repr. 1907), p. 161; Conder & Kitchen, *Survey of Western Palestine*, I: 391.

¹⁵ J. Sauvaget, *La Poste aux chevaux dans l'empire des Mamelouks* Adrien-Maison-neuve (Paris, 1941), p. 73, n. 291; M. Meinicke, *Die Mamlukische Architektur in Ägypten und Syrien*, volumes I-II (Gluckstadt, 1992), II: 22, no. 86; Ibn Faḍl Allāh al-'Umārī, *al-Ta'rif bi l-muṣṭalah al-sharīf*, ed. M.H. Shams al-Dīn (Beirut, 1308/1988), p. 248.

The fourth bridge (Fig. 2, No. 4), Jisr Jindas¹⁶, located between Ramla and Lydda, is the best documented of the medieval bridges and is dated by inscription to 671/1273. The inscription is repeated on both sides of the bridge and in each case is framed by a pair of lions each holding a small creature in its fore paws. The design of the bridge is fairly conservative with a flat deck running over three arches of nearly equal size. The structure is re-enforced by two re-used Roman columns inserted into each pier. The most unusual feature of the design is the thickness of the piers, which nearly equals the arch spans, considerably inhibiting the water flow. The pointed cutwaters do something to ameliorate this effect. However, the large quantities of silt indicate a reduction in flow on the upstream side. The survival of the bridge can only be attributed to the seasonal nature of the Wādī Musara and the strength of the masonry.

The fifth bridge is located near the town of Yibna — Crusader Ibellin¹⁷. The design of this bridge is nearly identical to that of Jisr Jindas with three pointed arches with two central piers re-enforced by triangular cutwaters on the up-stream side. On the downstream side and at the ends of the abutments the bridge is supported by narrow buttresses with sloping cills. Unlike Jisr Jindas there is no decoration or inscription on the Yibna Bridge, although there is a possible inscription or signature carved into one of the stones at the south end of the bridge. Clermont Ganneau and others have demonstrated that the bridge contains a large amount of re-used Crusader masonry (possibly derived from the dismantled castle).

One important difference between this bridge and Jisr Jindas is the width of the piers- at Jisr Jindas the width of the piers nearly equals that of the arch span, whereas in the Yibna Bridge the piers are less than 1/2 of the arch span making it both more elegant and structurally safer. Historical sources, which refer to the construction of a bridge at Yibna by Baybars in 671-2/1273-4 confirm the Mamluk date of this structure.

¹⁶ Conder & Kitchener, *Survey of Western Palestine*, II: 251; C. Clermont-Ganneau, *Archaeological Researches in Palestine*, transl. from French J. McFarlane (London, 1896-1899), II: 110-117; P.L.O. Guy, "Archaeological evidence of Soil Erosion and sedimentation in Wadi Musara", *Israel Exploration Journal*, 4 (1959): 77-87; *Répertoire Chronologique d'épigraphie Arabe*, E. Combé et al. (Cairo, 1931-), XII: no. 4660; L.A. Mayer, *Saracenic Heraldry: A Survey* (Oxford, 1933), pp. 106-110; Meinicke, *Die Mamlukische Architektur*, II: 157; Creswell *Muslim Architecture of Egypt*, II: 150-154.

¹⁷ Conder & Kitchener, *Survey of Western Palestine*, II: 251; Clermont-Ganneau, *Archaeological Researches*, II: 174, 182; Meinicke, *Die Mamlukische Architektur*, II: 38, no. 170.

The sixth bridge is located on the Wādī Sukrayr near the destroyed village of Isdud¹⁸. The design of the bridge is very similar to Jisr Jindas and Yibna with a flat deck carried over three arches. As in the other bridges the upstream side is re-enforced by triangular cutwaters and the downstream side is strengthened by thin buttresses with sloping cills. Unfortunately, the original west and east faces of the main central arch have been destroyed and the exposed vault has been consolidated by re-enforced concrete. Despite this fact the bridge remains strong and is still in use to carry the southbound traffic of the modern North-South motorway route 42. The ratio of pier thickness to span is similar to the Yibna Bridge with piers less than half the width of the arches.

Although we have no direct evidence for the date of construction, its similarity to Jisr Jindas and the bridge at Yibna combined with its position on the *Via Maris* suggest that it too was built during the reign of Sultan Baybars.

CONCLUSION

A number of conclusions can be drawn from this brief review of medieval bridges in Palestine. Perhaps the most obvious conclusion is that the location of the bridges mark the intersection of the major rivers and wadis with major overland routes, in particular that of the *Via Maris* which leads from Egypt to Syria via the coastal plain of Palestine and formed the central axis of the Mamluk state. Related to this point is the observation that the location of the bridges also reflects the position of the main rivers. The fact that there are three large bridges in the southern coastal plain away from the mountains is a geographical necessity as this links with the shortest and the most viable route from Egypt. Further north however, the *Via Maris* followed an inland road skirting the base of the highlands avoiding the necessity for large bridges over the Yarqon (ʿAwja) and other large rivers further north along the coast. Instead there are a number of smaller bridges over smaller wadis, such as that at Jaljuliyya and Lejjun¹⁹.

¹⁸ Clermont-Ganneau, *Archaeological Researches*, II: 186, Conder & Kitchener, *Survey of Western Palestine*, II: 422, Meinicke *Die Mamlukische Architektur*, II: 38.

¹⁹ A.D. Petersen, "Jaljuliyya: a village on the Cairo Damascus Road", *Levant*, 29 (1997): 95-114; Petersen, *Gazetteer of Buildings*, pp. 201-2.

Secondly it is noticeable that there is no evidence for the construction of bridges by the Crusaders despite the fact that both Jisr Jindas and the bridge at Yibna contain re-used Crusader material. There are a number of possible explanations for the absence of Crusader bridge construction one of which is that the Crusaders used the sea as the main means of long distance communication.

The final point which is borrowed from Nicholas Brooks' study of Medieval European bridges²⁰ is that bridges represent a way of extending and defining territory of the power which has constructed them, in this case the Mamluk rulers. If we look again at the location of the bridges it is noticeable that they all relate to the Damascus-Cairo line. For example, the fact that there is no southern crossing point on the Jordan may be significant, perhaps as a defensive measure to discourage contact between two sides of the Jordan or perhaps as a symptom of urban activity/settled life in southern and central Jordan during the Mamluk period. In this connection it is worth reminding ourselves that much of the northern coast of Palestine was depopulated and allowed to revert to marshland as part of official policy during the Mamluk period. By choosing where to build bridges and where not, the Mamluks were therefore quite consciously defining a territory in which Palestine was a bridge between the two centres of power.

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²⁰ Brooks, "Medieval European Bridges", pp. 23-4

No.	Name	River/Wadi	Roman origin	Medieval date	Decoration	Inscription	Arch form	Associated structure
1.	Jisr Banāt Ya‘qūb	R. Jordan	Y	C13th	?	?	pointed	<i>khān</i>
2.	Umm al-Qanāṭir	R. Jordan	?	Pre-C10th	?	?	pointed	none
3.	Jisr al-Mujamiyya	R. Jordan	Y.	C12th or earlier	?	?	pointed and round	<i>khān</i>
4.	Jisr Jindas	Wādī Musara	Y.	1273 A.D.	lions	Y	pointed	none
5.	Jisr Yibna	Nahr Rubin	?	C13th	none	signature?	pointed	none
6.	Jisr Isdud	Wādī Sukrayr	?	C13th	none	none	pointed	none

Table 1: Architectural summary

No.	Name	No. of Arches	Span(s) m.	Rib thickness	Pier width(s)	Bridge width	Bridge length	Clear opening
1.	Jisr Banāt Ya‘qūb	4	?	?	?	?	?	?
2.	Umm al-Qanāṭir	10	1.44	?	1.44	1,443-4,0	21.00	14.4 (50%)
3.	Jisr al-Mujamiyya	3+	8.9	0.8?	N/A	?	70.00	?
4.	Jisr Jindas	3	5.19 (centre) 5.38 (north) 5.00 (south)	0.6m	4.23 5.00	15.00	35.00	15.57 (62.8%)
5.	Jisr Yibna	3	6.50 (centre) 5.45 (east) 5.12 (west)	0.46-0.50	2.17 2.14	112.62	31.00	17.07 (79.94%)
6.	Jisr Isdud	3	7-8	0.5-0.6	c.2.00	14.00	25.00	22.5 (84.9%)

Table 2: Structural summary

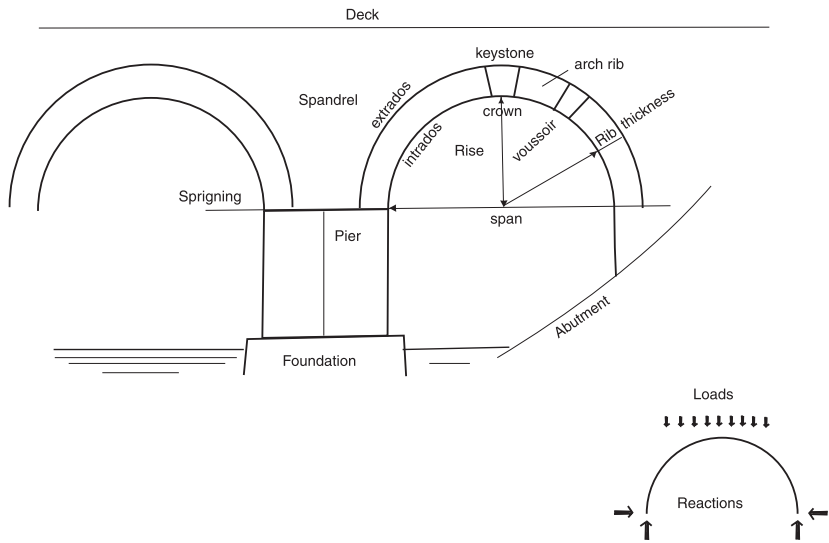


Fig. 1: Technical terms used in description of stone arched bridges

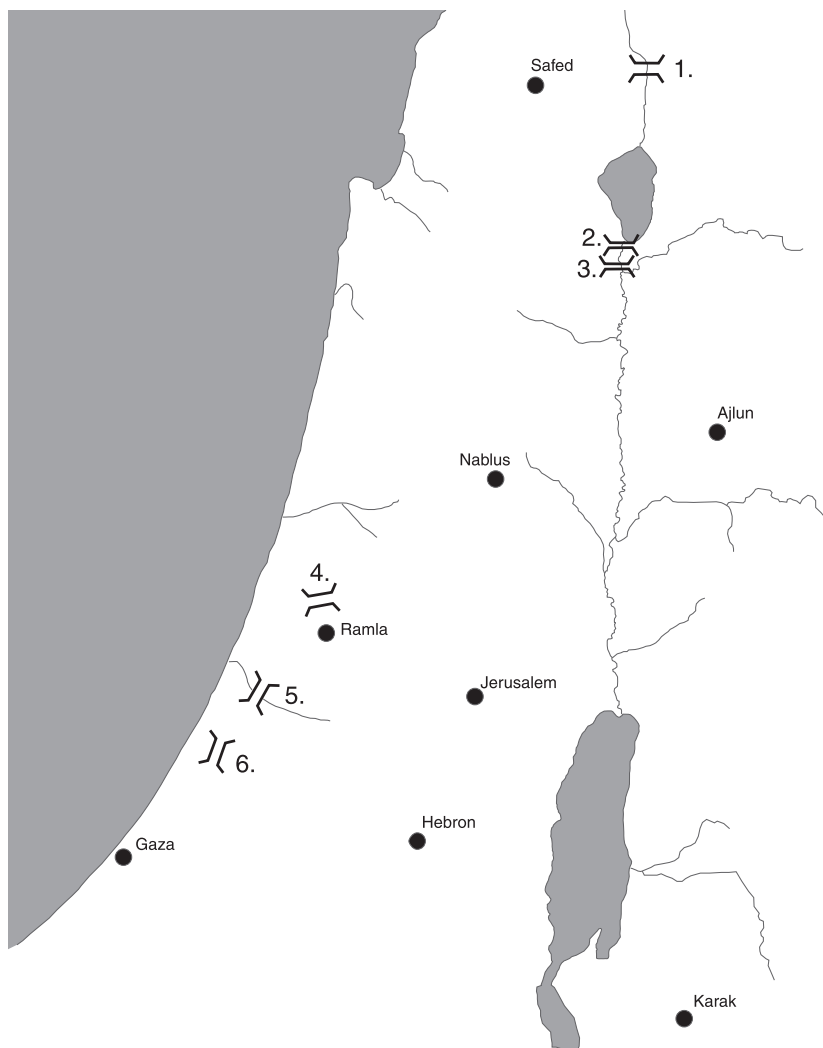


Fig. 2: Map of Palestine showing location of medieval bridges mentioned in the text

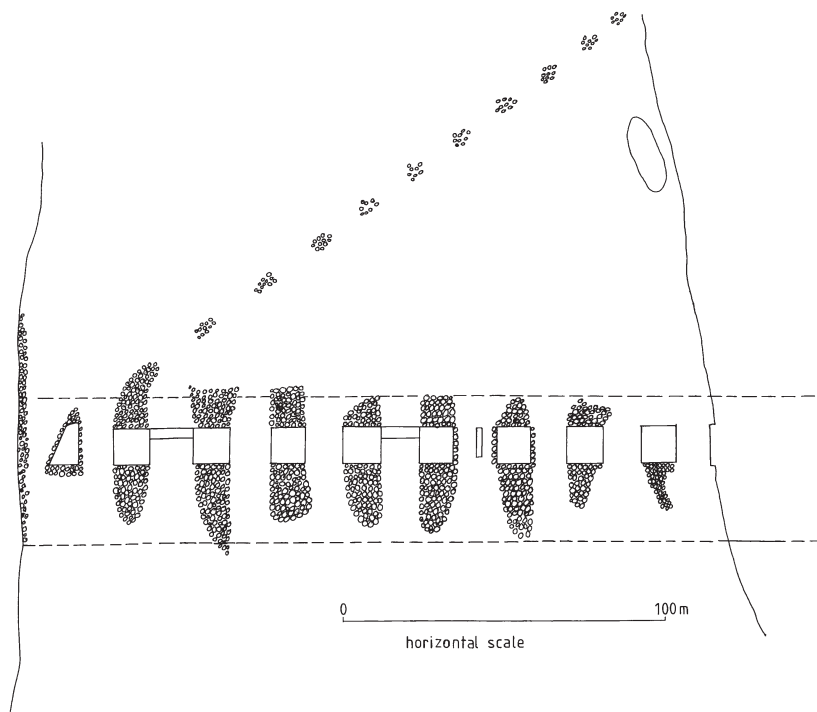


Fig. 3: Plan of Jisr al-Sidd from original in archives of the Palestine Department of Antiquities

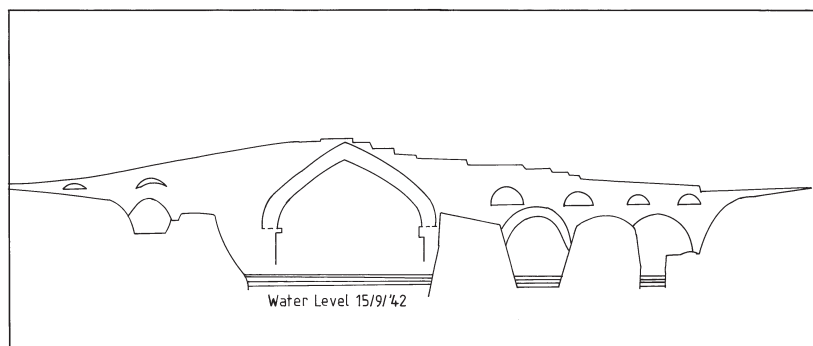


Fig. 4: Schematic section of Jisr al-Majāmi' from original in archives of the Palestine Department of Antiquities



Fig. 5: Jisr Jindas view of southeast side of bridge with cutwaters



Fig. 6: Jisr Jindas detail showing inscription and carved lions

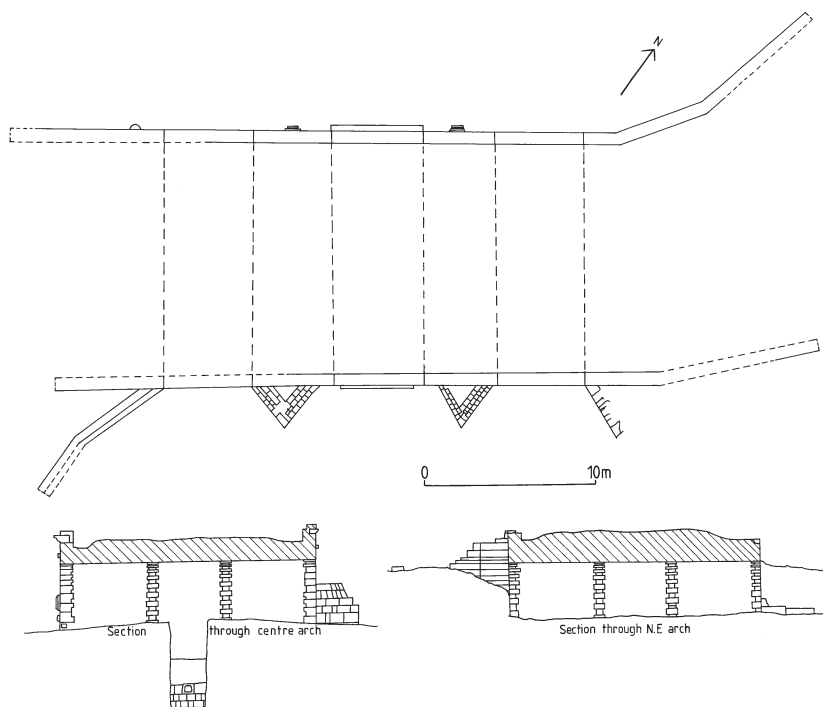


Fig. 7: Jisr Jindas plan of bridge after report by Norburn from original in archives of the Palestine Department of Antiquities

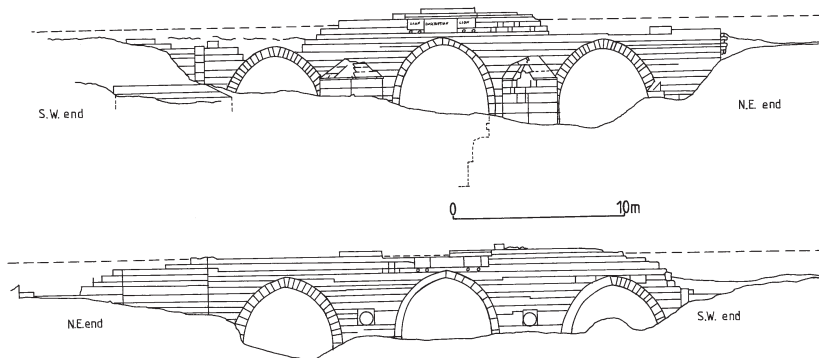


Fig. 8: Jisr Jindas section after report by Norburn from original in archives of the Palestine Department of Antiquities



Fig. 9: Bridge at Yibna showing cutwaters