

Parthian Brick Vaults in Mesopotamia, Their Antecedents and Decendants*

TRUDY S. KAWAMI
Columbia University

The architectural technology of Mesopotamia is most often illustrated by the massive mud-brick ziggurat. While the ziggurat is a visually striking structure, it in no way demonstrates the varied methods of construction available to the ancient builder. One of these methods was pitched brick vaulting, a Mesopotamian method for vault construction subsequently used in the West.

The pitched brick vault (fig. 1) is initially supported by a single bearing wall at the back. The courses of the vault are then laid at right angles to the courses of the wall. Each vault course is tipped somewhat off the vertical so that the initial courses lean against the back wall, and subsequent courses rest against the first. This vertical orientation of the vault courses, in addition to the tip or pitch, distinguishes the pitched vault from radial construction where the vault merges into the wall surface. A pitched vault is always identifiable by a change in the orientation of the brick courses in the interior of the vault. Unless obscured by the plaster, the springing point of the vault is marked by the juncture of the horizontal wall courses and the vertical vault rings.

The pitched brick wall is preferable to a radial vault in some circumstances because it is extremely stable and because it may be erected without the elaborate timber centering needed to support a radial vault during its construction. In earthquake-prone and timber-poor Mesopotamia these qualities would have been appreciated.

The pitched brick vault has long been considered a characteristic of Parthian architecture in Mesopotamia.¹ In that period it was constructed of the very large baked

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1 Oscar Reuther, "Parthian Architecture," *A Survey of Persian Art* (London and New York, 1938), 1:424; Heinrich Lenzen, "Architektur der Partherzeit in Mesopotamien und ihre Brückenstellung zwischen der Architektur des Westens und des Ostens," *Festschrift Carl Weickert* (Berlin, 1955), 122f.; Andre Godard, *The Art of Iran* (New York, 1965), 139; and M. A. R. Colledge, *Parthian Art* (Ithaca, N.Y., 1977), 64.

bricks typical of Parthian works.² These bricks were laid with a gypsum mortar. The quick-setting mortar, processed from local gypsum deposits, increased the ease and speed with which a vault could be constructed. While gypsum mortar is not necessary for the construction of a pitched brick vault, it is the standard binding agent of Parthian construction.

The Parthian remains at Assur in northern Mesopotamia yielded many examples of the pitched brick vault. They are varied in their form and use, and give some idea of the sophistication of the Parthian builders. The most striking element of the palace complex at Assur (fig. 2) is the slightly asymmetrical court with the four rectangular halls, or *eyvans*, opening on to it. This is the best known building at Parthian Assur, the first century A.D. palace, whose reconstructed west facade (fig. 3) is in the Staatliche Museum in East Berlin.³ The vault of the *eyvan*, 8 meters high with a span of 5½ meters, was constructed by the pitched method. It is an early demonstration of its use on a monumental scale. Unfortunately the museum reconstruction includes only the front of the vault; the interior has the flat roof of the museum ceiling.

While the pitched vault can be indefinitely extended in one direction, it is limited laterally. The supporting back and side walls may not be pierced by many large windows as this would weaken the walls and thus the vault. Another part of the Assur palace complex, the Pillared Hall northeast of the main court, shows how the Parthian architects overcame this limitation.⁴ Their intention seems to have been to enclose an area some 11.6 by 14.6 meters without blocking the interior by solid supporting walls. This space is half as large as the unroofed central court. The roof of the Pillared Hall, approximately 11.5 meters high, was formed of three pitched brick vaults placed parallel to each other. These vaults were, in turn, supported by two arcades also of pitched vaults running at right angles to the roof vaults (fig. 4). The characteristic change in the direction of the courses can be seen both on the roof vaults and in the supporting arcades.

The force of the very solid roof was channeled through these two levels of vaulting into the four square pillars and the outer walls of the building. This left an open interior space with relatively little obstruction of vision. Furthermore the walls could be pierced for windows in the upper areas without dangerously weakening roof support. One can only compare this spacious interior with the narrow elongated Assyrian throne room,⁵ or the densely columned Achaemenid halls⁶ to appreciate the difference, not only in construction, but in the quality of the interior space. The Pillared Hall is impressive, and it is a great pity that we have no knowledge of the purpose for which it was constructed.

Pitched brick vaults were also used below ground in the Parthian period at Assur where

2 The standard brick was approximately 40 cm square and 10 cm thick, with flat sides.

3 W. Andrae and Heinrich Lenzen, *Die Partherstadt Assur* (Berlin, 1933), pls. 48 and 50; and Colledge, *Parthian Art*, pl. 2.

4 Andrae and Lenzen, *Assur*, pl. 43f and pls. 11, 13d and 22b; and Colledge, *Parthian Art*, 50, fig. 21 and p. 66.

5 Henri Frankfort, *The Art and Architecture of the Ancient Orient* (Baltimore, 1963), 75, fig. 30 and p. 78.

6 *Ibid.*, 218f.

they covered tomb chambers.⁷ As tomb chambers they have been documented earlier at various sites in the Near East, including Susa in southwest Iran.⁸

However, the origins of the pitched brick vault appear to be Mesopotamian rather than Iranian. The British excavations at Tell al-Rimah, northwest of Nineveh, have amply documented the building form.⁹ One of the most remarkable examples, from a technical point of view, is a structure of unknown purpose on the southwest side of the mound. Dated about 2000 B.C., the building is formed by at least two tiers of pitched vaults. The actual size of the building is as yet unknown, but the excavated portion covers an area 7½ by 12 meters. The vaults of the structure are not the basically simple vaults seen at Assur, but rather domical vaults formed by either two or four intersecting pitched vaults. Such domes have a distinctive pattern formed by the meeting of the two sets of brick courses. The four-part domes are constructed by beginning a pitched vault at each corner of the room to be covered, and adding a course to each vault until they meet forming a dome. The Tell al-Rimah examples of this type have the characteristic diamond pattern resulting from this method of construction (fig. 5). Both types of domes are strong and capable of bearing great weight. Their characteristically flat profile distinguished them from the more hemispherical radial domes.

It is clear from this unusual structure that the Tell al-Rimah builders were also familiar with radial arches. A doorway between two compartments in the vaulted building is itself a radial arch though somewhat deformed by the stresses of time.¹⁰ Since the builders knew both construction principles, the employment of the pitched vaults was an intentional choice. The fact that the pitched vaults could be constructed without wooden centering in an area with little timber undoubtedly was a factor in that choice.

The vaulted structure at Tell al-Rimah once bore a building of some sort, but only traces of that building and its function remain. It is not clear if the vaulted remains were merely a massive basement, or if the room-like chambers were somehow utilized. The connecting door between the chambers suggests that the spaces were used. In spite of our ignorance concerning the significance and function of the building, we can appreciate the remains for their complexity, and their economy of construction using mud brick and mud mortar rather than baked brick and gypsum.

The complex pitched brick vaults of Tell al-Rimah suggested to the excavator, David Oates, that the technique had been developed much earlier.¹¹ Another smaller pitched vault from the Isin-Larsa levels at Nippur has since been published,¹² but no earlier examples of

7 Andrae and Lenzen, *Assur*, pls. 48 and 50.

8 For a description of these vaults see the excavation reports by Roman Ghirshman in *Arts Asiatique* 10 (1964), 19; 11 (1965), 12–17, figs. 8–11 and 15–17; 13 (1966), 23f and figs. 17–19; 15 (1967), 25 and figs. 25 and 26; and 17 (1968)ll, 29 and fig. 10. For further examples, see K. A. C. Creswell, *Early Muslim Architecture* (Oxford, 1932), 1:349, n. 1.

9 David Oates, "The Excavations at Tell al-Rimah, 1964," *Iraq* 27 (1965), pl. XXb and p. 77; and *idem*, "The Excavations at Tell al-Rimah, 1968," *Iraq* 32 (1970), 20–23, and pls. V–VIII.

10 Oates, *Iraq* 32, pl. VIc.

11 *Ibid.*, 22.

12 Donald C. McCowan and Richard C. Haines, *Nippur I. Temple of Enlil, Scribal Quarter and Soundings . . .*, Oriental Institute Publication 78 (Chicago, 1967), 61 and 77, and pls. 48 A and B, and 79.

the technique have come to light yet. This may be because pitched vaults are difficult to identify once they are destroyed. Since they require no special foundations or types of walls, only the fortuitous preservation of part of a pitched course would document their presence.

Pitched vaults occurred widely in Mesopotamia and Iran in the second millennium B.C., as well as in New Kingdom Egypt.¹³ There, as in Mesopotamia, the technique was used in domestic architecture and utilitarian structures such as granaries. In these non-royal and non-public buildings limited time, money, and effort emphasized the virtues of the strong and easily constructed pitched vault. Stone masonry, the preferred material for more ostentatious buildings such as palaces and major temples does not lend itself so easily to the pitched construction.

The remains at Tell al-Rimah make clear that the Parthians did not invent the pitched brick vault. Nevertheless they regularly used it, not only in their domestic and utilitarian architecture, but on a monumental scale in lavishly ornamented official structures such as the Assur palace. Furthermore, they used baked brick and gypsum mortar which insured a permanence appropriate to a large state building.

The Parthians passed to their successors the Sasanians the use of the pitched brick vault in monumental royal buildings. The Taq-i Khusro, the great third-century throne hall in the Sasanian capital at Ctesiphon, is a restatement, in both form and structure, of the Assur palace.¹⁴ The main vault, arching 34 meters into the air while spanning 24 meters, is a monument not only to its architects and engineers but also to the powerful, centralized Sasanian monarchy. The change in orientation of the courses clearly identifies the pitched vault of the great arch, as well as the smaller vaults that covered the adjacent rooms and corridors.

The pitched brick vault was passed in turn from the Sasanians to the builders of the early Islamic period. It was particularly favored for large royal complexes such as the 8th-century A.D. Abbasid palace at Ukhaidir which was constructed very quickly in a location without timber.¹⁵ Again, restrictions in time and money favored pitched vaulting.

The Parthians may have taught the principle of pitched vaulting not only to the Sasanians, but to the Romans too. Although justly famous for their constructions of brick, the Romans employed only radial vaults in their native Italy.¹⁶ The earliest Roman pitched vault appears in Anatolia at Aspendos, a site on the southern coast best known for its well-preserved theater.¹⁷ The pitched brick vault (fig. 6) occurs in the basilica, a commercial and legal building of the late third century A.D. located northwest of the theater. The entire rectangular structure, over 90 meters long, was supported by a sturdy substructure

13 S. Clark and R. Engelbach, *Ancient Egyptian Masonry* (London, 1930), 183–85, and figs. 214–16.

14 Arthur Upham Pope, *Persian Architecture* (New York, 1965), 54 and 56, figs. 43, 44, and especially 46.

15 Gertrude Bell, *Palace and Mosque at Ukhaidir* (Oxford, 1914), 14 and 16, and pl. 16, fig. 2.

16 The use of concrete in the construction of vaults led to technical development in a different direction. For the early Roman use of concrete see J. B. Ward-Perkins, *Roman Imperial Architecture* (New York, 1981), 97–100. I would like to express my gratitude to Professor Alfred Frazer whose discussions of Roman architectural practice were most helpful.

17 *Ibid.*, 276, and fig. 176; and *idem*, "Notes on the Structures and Building Methods of Early Byzantine Architects," in D. Talbot Rice, ed., *Great Palace of the Byzantine Emperors* (Edinburgh, 1958), 2:96, and pls. 32 a and b.

consisting of one lengthy pitched vault. The change in the orientation of the courses demonstrates the method of construction.

In the basic surveys of Roman architecture, the appearance of these non-Roman vaults in Roman buildings is ascribed accurately, though vaguely, to "eastern influences."¹⁸ We may now amend this to read "influences from Parthian Mesopotamia."

We know that Parthians in the Roman army contributed to changes in military practice,¹⁹ and cooperation in architectural and technical matters may well have followed. The workmen responsible for the Aspendos basilica could have been Parthians captured by the Romans in one of their numerous military actions. On the other hand, they may have been free Parthian craftsmen, or local workers under the direction of a Parthian architect. The disintegration of Parthian control in Mesopotamia in the early third century, and the concurrent decline in state-supported construction, may have induced masons, bricklayers, and skilled construction workers to seek employment in the more stable areas under Roman administration.

As Roman interest shifted more strongly to the east, the pitched vault appeared in a specifically imperial structure. In the late third or very early fourth century A.D., the emperor Galerius constructed his mausoleum at Salonika on the northeastern coast of Greece.²⁰ The structure is essentially a circular, domed space originally intended to shelter the imperial ashes. Inside the building the walls are broken by a series of rectangular niches extending from the central space. These exedrae are constructed of pitch-vaulted domes. The diamond pattern formed by the intersection of the courses recalls the same type of vault built over two thousand years earlier at Tell al-Rimah.

The tradition of pitched vaulting continued from late Roman into early Byzantine times, and appears in the Great Palace of the Byzantine emperors constructed in Constantinople.²¹ The large aspidal hall in the palace was supported by a complex substructure of pitched domical vaults. These vaults have the characteristic vertical courses and the flat profile of this vaulting technique. The function of these early Byzantine vaults in Constantinople is the same as those at Tell al-Rimah, the strong and economical support of an imposing structure.

The discovery of the vaults at Tell al-Rimah has made clear the antiquity of the pitched vault construction in the Near East. The Parthians incorporated this technique into official, or royal, architecture on a monumental scale. These same Parthians, it seems, were responsible for the spread of the tradition not only eastward with Sasanian and Islamic builders, but westward to the Romans. The Parthian monumental pitched vault is a tangible architectural link between East and West.

18 Axel Boethius and J. B. Ward-Perkins, *Etruscan and Roman Architecture* (Baltimore, 1970), 451. See also Richard Krautheimer, *Early Christian and Byzantine Architecture* (Baltimore, 1965), 79–80.

19 Emilio Gabba, "Sulle Influenze Reciproche degli Ordinamenti Militari dei Parti e dei Romani," *La Persia e il Mondo Greco-Romano*, Problemi attuali . . . Accademia Nazionale dei Lincei 76 (1966), 51ff.

20 Ward-Perkins, in *Great Palace*, pls. 33 a and b. See also Ejnar Dyggve, "La region palatiale de Thessalonique," *Proceedings of the Second International Congress of Classical Studies, Copenhagen, 1954* (Copenhagen, 1958), 353–56. I would like to thank Prof. Eugene Kleinbauer for this citation and for many helpful comments about the structure.

21 Ward-Perkins, in *Great Palace*, 52–104.

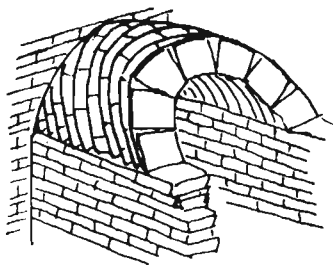


Fig. 1 Pitched brick vault

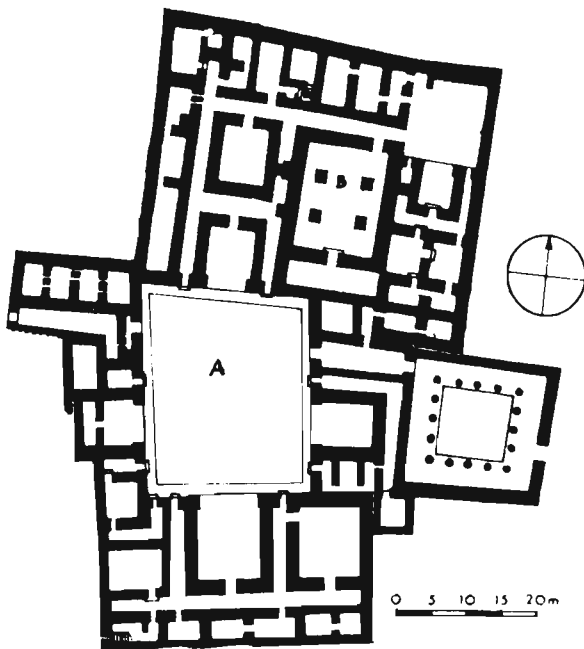


Fig. 2 Assur, Parthian palace, plan. A: Central Court; B: Pillared Hall (after Colledge, 50)

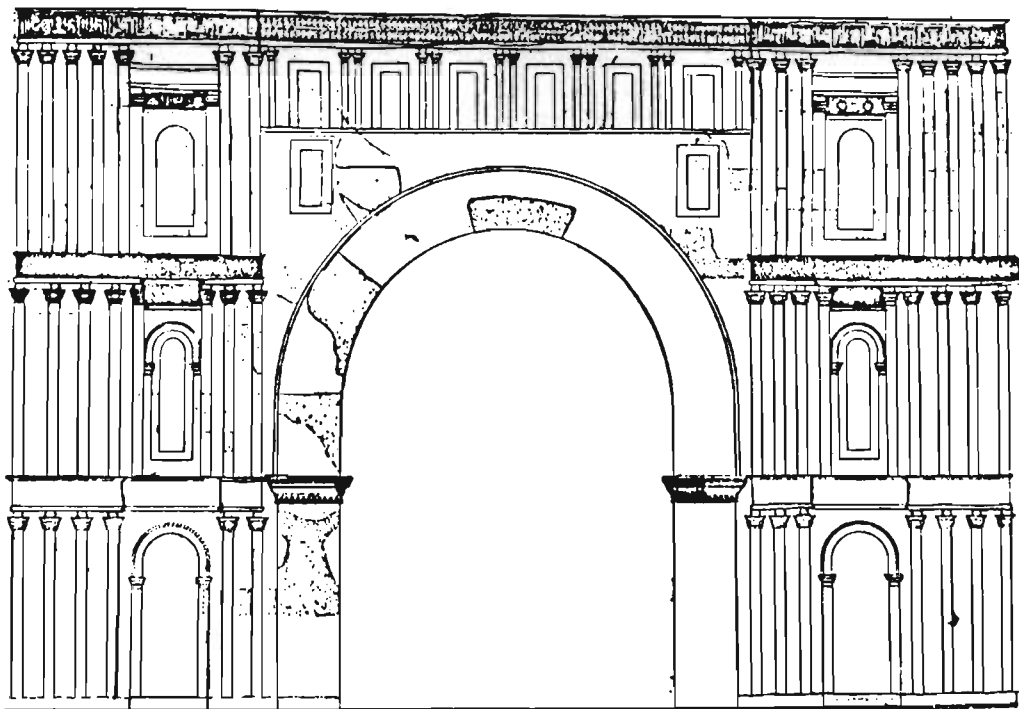


Fig. 3 Assur, Parthian palace, facade of Central Court.
Reconstruction, Staatliche Museen zu Berlin, D.D.R.

Fig. 4 Assur, Parthian palace, Pillared Hall. A: Schematic reconstruction; B: Vaulting system

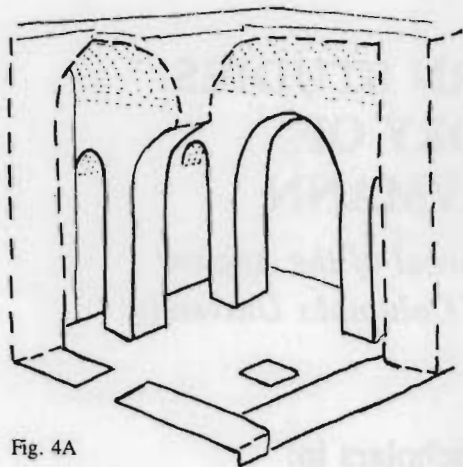


Fig. 4A

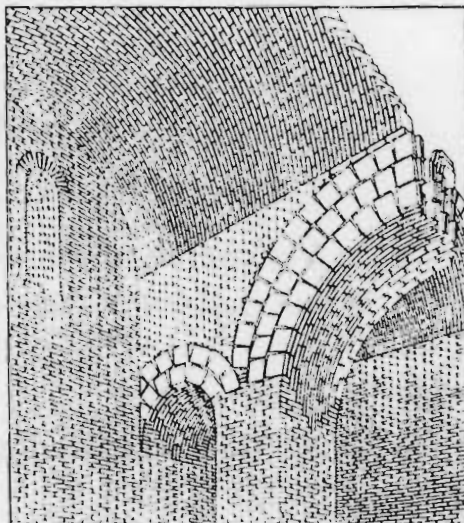


Fig. 4B

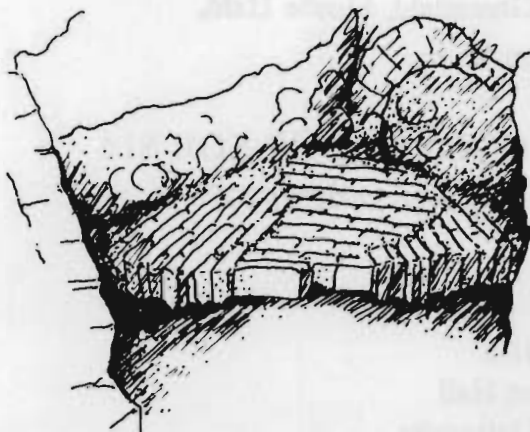


Fig. 5 Tell al-Rimah, vaulted structure, domical pitched vault (after Oates, *Iraq* 32 [1970], pl. V,b)

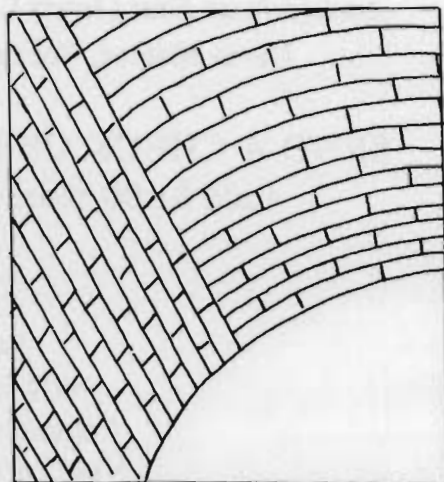


Fig. 6 Aspendos, basilica, vaulted substructure (after Boethius & Ward-Perkins, pl. 200)