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ARCHITECTURE III. SASANIAN PERIOD
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# ARCHITECTURE III. SASANIAN PERIOD

**ARCHITECTURE**

iii. Sasanian Periods

1. *Building materials*. Sasanian architecture is characterized by the widespread use of mortar masonry and the associated vaulting techniques. Although mud brick had been developed long before, and mortar constructions were known in Parthian times, both became preeminent in the high-standard architecture of the Sasanians. Mud brick remained a most important building material (e.g. Dāmḡān, Istakhr/Eṣṭaḵr, Ḥāǰīābād, Kīš, Ctesiphon, Kuh-i Khwaja/Kūh-e Ḵᵛāǰa), and only its impermanence shifts our attention to the better preserved stone and brick ruins of Sasanian architecture. Among these, rubble stone masonry with gypsum mortar is predominant. Brickwork was frequently used for vaults and domes, although there are a number of buildings made entirely of brick (e.g. Dastegerd, Ayvān-e Karḵa, Ctesiphon, Taḵt-e Solaymān). Dressed ashlar appears sporadically, mainly in the early (e.g. Bīšāpūr, Fīrūzābād, Nūrābād, Pāykūlī) and late (e.g. Ṭāq-e Gerra, Darband, Taḵt-e Solaymān, Kangāvar) phases of the empire, and seems to be due to western influence (H. Wulff, *Traditional Crafts of Persia*, Cambridge, Mass., 1966, p. 102).

2. *Construction and structural types*. (a) *Vaulted constructions*. Sasanian vaulting techniques depend largely on the special qualities of gypsum mortar,

which allows vaulting without centering because of its short setting time. Barrel vaults with "pitched courses," the most frequent system, owe their elliptical shape and their significant step out above the impost to this technical procedure, which requires only a back wall or a narrow strip of centering for the first courses, with the following ones successively glued in front (K. A. C. Creswell, *Early Muslim Architecture* 1/2, Oxford, 1969, p. 544; O. Reuther, "Sasanian Architecture," in *Survey of Persian Art* I, p. 498). Notwithstanding its practical advantages, vaulting without centering prevented the development of geometrically advanced constructions. Semicircular barrel vaults appear only when built on centering as a voussoir arch with "lying courses." The cross vault, resulting from the intersection of two barrel vaults at right angles, was not developed. There are no examples of pointed arches built by formal intention, although they occur as a result of building practice in lesser monuments (e.g. Qaṣr-e Šīrīn) (G. L. Bell, *Palace and Mosque at Ukhaidir*, London, 1914, p. 51). The standard unit of the rectangular barrel-vaulted room was frequently enlarged by vaulted bays. Adjoining semidomes occur rarely (e.g. Kīš, Bozpar, Negār, Sarvestān), although in vernacular architecture the use of the squinch vault, probably an ancient technique and one widely regarded as the origin of the Iranian dome, results in a hybridization of semidome or dome and cloister vault (A. Godard, "Voûtes iraniennes," *Athar-é Iran* 4, 1949, p. 221). With the barrel-vaulted *ayvān*, a rectangular room with the front side open, the visible shape of the vault became the dominant feature of the facade. Already present in Parthian time, the *ayvān* became the most conspicuous element of Sasanian and later Iranian architecture.

(b) *Domed constructions*. The propagation of the dome on squinches above a square hall may be regarded as the most significant Sasanian contribution to Middle-Eastern architecture. This most uncomplicated and solid of all constructive systems already appears fully developed in the buildings of Ardašīr I in Fīrūzābād (Plate V). Its tectonic disposition remained basically unchanged throughout the Sasanian period and had a decisive impact on Islamic architecture; its empirical form clearly distinguished Eastern dome construction from the abstract geometrical concept of Western domes with pendentives (J. Rosinthal, *Pendentifs, trompes et stalactites dans l'architecture orientale*, Paris, 1928, p. 43). The variety of squinch forms demonstrates an increasing effort to find satisfying forms for what was originally a purely constructive element. In its early stage (e.g. Fīrūzābād) the cupola proper does not yet have a perfectly circular base, but rises on a fairly well rounded octagon. Later examples (e.g. Qaṣr-e Šīrīn) draw nearer to geometric

perfection, which is finally achieved in Islamic architecture.

The elevation of the domed hall consists of three horizontal zones: (1) plain walls, generally with doors or arches at the four axial intercepts; (2) a zone of transition including the corner squinches and generally windows or decorative niches at the main axes; (3) the cupola proper. The addition of barrel-vaulted bays to all four sides of the square produced the mature scheme that was to become a standard type for representative architecture in Iran until the present. This cruciform plan, based on the *čahār-ṭāq*, the square with four arches, appears in the earliest examples of Sasanian architecture, (e.g. Taḵt-e Nešīn in Fīrūzābād); it may have been inspired by Roman and Parthian architecture, although the central square was generally covered by cross or barrel vaults in those monuments.

(c) *Columns and other supporting constructions*. With the introduction of far-spanning vaults, the use of columns as constructive elements was widely discarded. There are examples of archaizing slender columns with bases, capitals, and sometimes fluted shafts that maintain Achaemenid or Hellenistic traditions (e.g. Bīšāpūr, Nūrābād, Kīš), while those of later monuments (e.g. Bīsotūn, Ṭāq-e Bostān) reflect a fresh Western, Byzantine influence. But most often the column was transformed into a massive, round or rectangular pillar suitable for vaulted masonry constructions.

Apart from their use in colonnades (e.g. Kangāvar), pillars distinguish a characteristic group of generally three-aisled halls covered by longitudinal or transversal barrel vaults (e.g. Čāl Ṭarḵān, Dāmḡān, Ctesiphon, Taḵt-e Solaymān, Tepe Mīl). Nonetheless the typical supporting elements remained the massive wall, and pillars more often appear as relics of a wall pierced by arches than as individual tectonic members.

(d) *Constructive and decorative details*. Clay remained the chief coating material for flat and vaulted roofs as well as for floors which were frequently covered with gypsum plaster, stone, or in rare cases, with Roman influenced mosaics (e.g. Bīšāpūr, Ctesiphon). Plaster of Paris, frequently painted (Bīšāpūr, Ayvān-e Karḵa, Kīš), was widely used for building facings and for the dominant mode of architectural ornamentation, the stucco relief (Čāl Ṭarḵān, Dāmḡān, Ḥājīābād, Kīš, Ctesiphon) (D. Thompson, *Stucco from Chal Tarkhan*, London, 1976; J. Kröger, *Sasanidischer Stuckdekor*, Mainz, 1982; M. Azarnoush, “Excavations at Hâjîâbâd, 1977,” *Iranica Antiqua* 18, 1983, pp. 159ff.). The traditional stepped revetment remained a favorite decorative element,

normally with four rectangular stages, which were already becoming dovetail-like at the late Sasanian Ṭāq-e Gerra.

3. *Functional types of buildings*. (a) *Religious architecture*. Frequent reference to sacred fires in Pahlavi texts indicate the important role that sanctuaries of the Zoroastrian state religion played in Sasanian architecture, but their architectural type remains disputed (F. Oehlmann "Persische Tempel," *Archäologischer Anzeiger*, 1921, pp. 273ff.; U. Monneret de Villard, "The Fire Temples," *Bulletin of the American Institute for Persian Art and Archaeology* 4, 1936, pp. 175ff.; K. Schippmann, *Die iranischen Feuerheiligtümer*, Berlin, 1971; M. Boyce, "On the Zoroastrian Temple Cult of Fire," *JAOS* 95, 1975, pp. 454ff.; Y. Yamamoto, "The Zoroastrian Temple Cult of Fire in Archaeology and Literature," *Orient* 15, 1979, pp. 19ff.; 17, 1981, pp. 67ff.). The prevailing theory suggests that the main sanctuary structures were a freestanding *čahār-ṭāq*, under which the sacred fire, shining through the four lateral arches, was exposed to worshipers during the religious services, and a small *ātešgāh* some distance away, where the fire was kept at other times (A. Godard, "Les monuments du feu," *Athār-é Iran* 3, 1938, pp. 7ff.; K. Erdmann, *Das iranische Feuerheiligtum*, Leipzig, 1941, pp. 46ff.). Apart from religious prescriptions that raise doubts about this kind of cult practice (*Dârâb Hormazyâr's Rivâyat*, ed. M. R. Unvala, I, Bombay, 1906, pp. 60, 65ff.), archeological field work suggests another type of sanctuary: a closed chamber, where the fire was permanently maintained and served by priests, with adjoining ambulatories or rooms for worship (E. Herzfeld, *Iran in the Ancient East*, London, 1941, pp. 301ff.; E. Keall, "Archaeology and the Fire Temple," in C. J. Adams, *Iranian Civilization and Culture*, Montreal, 1972, pp. 15ff.; D. Huff, "Das Imamzadeh Sayyid Husain und E. Herzfelds Theorie über den sasanidischen Feuertempel," *Stud. Ir*. 11, 1982, pp. 197ff.). If the suggested identification of the Taḵt-e Nešīn in Fīrūzābād with a fire temple of Ardašīr I proves right, the early type was a square, domed room with four interior bays and with *ayvān*s or rooms added to the four facades (Huff in *Archäologischer Anzeiger*, 1972, pp. 517ff.). A unique, semi-subterranean structure at Bīšāpūr, convincingly attributed to Šāpūr I, is believed to be an ambulatory type fire temple because of its corridors; these surround a courtyard-like square of uncertain roofing, apparently associated with Anāhitā, as it was connected with an underground water canal (Ghirshman, *RAA* 12, 1938, p. 14; see, for a different interpretation, R. N. Frye, "The So-called Fire Temple of Bishapur," in *The Memorial Volume of the VIth Internalional Congress of Iranian Art and Archaeology, Oxford, Septemher 11-16th*, 1972, Tehran, 1976, p.93). The Sasanian phase of the mud brick

structure at Kūh-e Ḵᵛāǰa, identified as a fire temple by an altar in its principal building, had a square, domed sanctuary surrounded by corridors and halls, with a vast complex of subsidiary rooms and *ayvān*s around a central court (Herzfeld, op. cit., pp. 291ff.; G. Gullini, *Architettura iranica*, Torino, 1964, pp. 87ff.). A similar layout was found at Taḵt-e Solaymān, tentatively dated to the 6th century, which has been identified, on the basis of historical tradition and the excavation of clay bullae bearing priests' names and titles, as the shrine of Ādur Gušnasp (Figure 11), one of the three most important Ādur Wahrāms (see *Ātaš*; the others, Ādur Farnbaγ and Ādur Burzēnmihr, have not yet been precisely localized. A second shrine excavated here, beside a dome-ambulatory temple, revealed an altar socle in a small sanctuary, preceded by two successive pillar halls rather than ambulatories (H. H. Von der Osten and R. Naumann, *Takht-i Suleiman*, Berlin, 1961; R. Nauman, "Takht-i Suleiman," *Archäologischer Anzeiger*, 1975, pp. 109ff.; idem, *Die Ruinen von Tacht-e Suleiman und Zendan-e Suleiman*, Berlin, 1977, pp. 57ff.; D. Huff, "Takht-i Suleiman," *AMI* 10, 1977, pp. 211ff.). The Čahār Qāpū at Qaṣr-e Šīrīn, attributed to Ḵosrow II, seems to have been another dome-ambulatory type temple within a large architectural compound (Bell, op. cit., pp. 51ff.; Reuther, op. cit., pp. 552ff.; differently J. Schmidt, "Qaṣr-i Širin," *Baghdader Mitteilungen* 9, 1978, pp. 39ff.).

A great number of *čahār-ṭāq* ruins, surveyed all over Iran and most frequent in Fārs and Kermān, are regarded as fire temples. Nearly all of them were closed to the outside by blocking walls in their bays or the surrounding vaulted corridors (L. Vanden Berghe, "Récentes découvertes de monuments sassanides dans le Fars," *Iranica Antiqua* 1, 1961, pp. 163ff.; idem, "Nouvelle découverte de monuments du feu d'époque sassanide," ibid., 5, 1965, pp. 128ff.; idem, "Les Chahar Taqs du Pusht-i Kuh, Luristan," ibid., 12, 1977, pp. 175ff.). See further D. Huff, "Sasanian Čahar Taqs in Fars," in *Proceedings of the IIIrd Annual Symposium on Archaeological Research in Iran*, Tehran, 1975, pp. 243ff.). The two types are represented by the excavated examples at Tūrang Tepe identified as a sanctuary by an altar socle, and at Qaḷʿa-ye Yazdegerd, respectively (J. Deshayes, "Un temple du feu d'époque islamique à Tureng Tépé," in *Le feu dans le Proche-Orient antique*, Leiden, 1973, pp. 31ff.; E. Keall, "Qal'eh-i Yazdigird, an Overview of the Monumental Architecture," *Iran* 20, 1982, pp. 51ff.). Several open air altars including those at Naqš-e Rostam and Tang-e Karam most likely served for some Zoroastrian religious practice (A. Stein, "An Archaeological Tour in the Ancient Persis," *Iraq* 3, 1936, pp. 175ff.; K. Erdmann, "Die Altäre von Naqsh-i Rustam," *MDOG* 81, 1949, pp. 6ff.;

D. Stronach, “The Kuh-i Shahrak Fire Altar,” *JNES* 25, 1966, pp. 217ff.). Christian churches discovered at Ḥīra, Ctesiphon, and Rahalīya have long prayer halls, mostly with two rows of pillars and tripartite choirs (Reuther, *Die Ausgrabungen der Deutschen Ktesiphon-Expedition*, Berlin, 1930, pp. 11ff.; D. Talbot Rice, “The Oxford Excavations at Hira, 1931,” *Antiquity* 6, 1932, pp. 276ff.; B. Finster and J. Schmidt, “Sasanidische and frühislamische Ruinen im Iraq,” *Baghdader Mitteilungen* 8, 1976, pp. 27, 40ff.).

(b) *Palaces*. Although palaces provide the best known examples of Sasanian architecture, the number of well defined monuments is smaller than generally assumed. They are characterized by a regular layout along an axis of symmetry and an obligatory *ayvān*. The two palaces of Ardašir I at Fīrūzābād, Qaḷʿa-ye Doḵtar (Figure 12) and Āteškada, both have as public reception areas a deep *ayvān* with lateral rooms, followed by a central dome and domed or barrel-vaulted subsidiary halls. A courtyard with *ayvān*s and large, uniform halls behind or in front of the reception area is generally regarded as the royal living quarters, although it gives the impression of belonging to the official area. Therefore the private lodgings may be assumed in small rooms on the upper floor that are otherwise unexplained (D. Huff, “Qaḷʿa-ye Dukhtar bei Firuzabad,” *AMI*, N.F. 4, 1971, pp. 127ff.; idem, “Ausgrabungen auf Qaḷʿa-ye Dukhtar bei Firuzabad, 1976,” *AMI* 11, 1978, pp. 117ff.).

There are few palaces remaining from the middle Sasanian period, during which the characteristic combination of *ayvān* and domed hall seems to have been abandoned. At the Ṭāq-e Kesrā, now generally attributed to Ḵosrow I (Reuther, op. cit., pp. 15ff.; O. Kurz, “The Date of the Taq-i Kisra,” *JRAS*, 1941, pp. 37ff.; differently Herzfeld, “Damascus: Studies in Architecture II,” *Ars Islamica* 10, 1943, pp. 59ff.), and at the probably contemporary *ayvān* building at Taḵt-e Solaymān (Nauman, *Die Ruinen von Tacht-e Suleiman*, pp. 44), the *ayvān* appears to be the only dominating element. The inadequately documented ʿEmārat-e Ḵosrow in Qaṣr-e Šīrīn and the nearby ruin of Hawš Kūrī, both attributed to the time of Ḵosrow II, also seem to lack a dome behind the *ayvān*, where a transverse structure of uncertain elevation and a square courtyard were located instead (J. de Morgan, *Mission scientifique en Perse* IV, Paris, 1896, pp. 341ff.; Bell, op. cit., pp. 44ff.; Reuther in *Survey of Persian Art* I, pp. 533ff.). Regular house-like units added to the rear seem to have been living areas. Both palaces stand on artificial terraces with double ramps like the ruin at Kangāvar, now thought to be a late Sasanian palace (V. Lukonin, “The Temple of Anahita in Kangavar” [in Russian], *VDI* 2/140, 1977, pp. 105ff., cf. G.

Herrmann, *The Iranian Revival*, Oxford, 1977, p. 107; M. Azarnoush, "Excavations at Kangavar," *AMI* 14, 1981, pp. 69ff.). Other terraces such as Tall Ḏahab and Ḥaram-e Kesrā at Ctesiphon (Reuther, *Ktesiphon-Expedition*, pp. 23ff.; E. Kühnel et al., *Die Ausgrabungen der zweiten Ktesiphon-Expedition*, Berlin, 1933, pp. 1ff.) or Sarmaǰ (L. Trümpelmann, "Die Terrasse des Hǰosrow," *Archäologischer Anzeiger*, 1968, pp. 11ff.) may have carried palace-like super structures as well.

The residential function of a number of monuments generally regarded as palaces has been questioned. The ground plan of the well-preserved building of Sarvestān suggests other than palatial use. Its dating in the mid-Sasanian period has also come into question because of its highly developed vaulting system, closely paralleled by early Islamic constructions such as Qaṣr al-Ḵarāna in Jordan (O. Grabar, "Sarvistan. A Note on Sassanian Palaces," in *Forschungen zur Kunst Asiens. Festschrift K. Erdmann*, Istanbul, 1968, pp. 1ff.; M. Siroux, "Le palais de Sarvistan et ses voûtes," *Stud. Ir*. 2, 1973, pp. 49ff.; L. Bier, *The "Sasanian" Palace near Sarvistan*, New York, 1979). The highly complex layout of the so-called palace of Šāpūr I in Bīšāpūr raises similar questions of function (Ghirshman, "Les fouilles de Châpour (Iran)," *RAA* 12, 1938, pp. 15ff.; idem, *Bîchâpour* II, Paris, 1956, pp. 11ff.; Huff, *Archäologischer Anzeiger*, 1972, pp. 517ff.). The three-naved buildings of Dāmḡān (F. Kimball, apud E. F. Schmidt, *Excavations at Tepe Hissar*, Philadelphia, 1937, pp. 327ff.), Čāl Ṭarḵān (Thompson, op. cit., pp. 3ff.), Tepe Mīl (Kröger, op. cit., pp. 202ff.), and Kīš (P. R. S. Moorey, *Kish Excavations 1923-33*, Oxford, 1978, pp. 134ff.) can be reasonably regarded as forerunners of similar, early Islamic palaces such as Kūfa and Tall al-Oḵayder but are formally connected with the second fire temple at Taḵt-e Solaymān and other cult buildings as well. There is little decisive evidence for the purpose of the hall on the city wall of Ayvān-e Karḵa (M. Dieulafoy, *L'art antique de la Perse* V, 1889, pp. 79ff.; Ghirshman, *MDAFI*, Paris, 1952, pp. 10ff.) or the buildings at Bozpar (L. Vanden Berghe, "Le tombeau achéménide de Buzpar," in *Vorderasiatische Archäologie. Festschrift A. Moortgat*, Berlin, 1964, pp. 243ff.), Behešto Dozaḵ (L. Vanden Berghe, "Les ruines de Bihisht-u Duzakh à Sultanabad," *Iranica Antiqua* 8, 1968, pp. 94ff.), and elsewhere. (c) *Cities and houses*. The political importance of city foundations in Sasanian Iran is indicated by the almost obligatory component of the sponsor-king's name in the name of the city. Although many attributions may concern some kind of re-founding or shifting of existing places, a number of original foundations are known, the standard pattern of which is a rectangular system of streets. The exceptional concentric and radiating plan of

the circular city of Ardašīr-ḵorra may reflect an individual decision by Ardašīr I, demonstrating the cosmological and sociopolitical ideas of his emerging empire (D. Huff, "Zur Rekonstruktion des Turmes von Firuzabad," *Istanbuler Mitteilungen* 19/20, 1969/70, pp. 319ff.; idem, "Der Takht-i Nishin in Firuzabad," *Archäologischer Anzeiger*, 1972, pp. 517ff.; idem, *AMI* 11, 1978, pp. 117ff.). Archeological evidence for other circular geometric city plans is scanty, although they appear at different periods in the ancient Orient and with different stages of refinement. The round layout of Hatra, the best known Parthian example, lacks a genuine geometrical concept. It is unlikely that the round perimeter of Dārābgerd is a prototype for Ardašīr-ḵorra, as it probably dates from the 8th century (Creswell, *Early Islamic Architecture* I/2, 1969, p. 21). The circular plan of Ctesiphon and the general topography of the site of al-Madāʾen are still under discussion (Reuther, in *Survey of Persian Art* I, pp. 2ff.; J. M. Fiey, "Topography of al-Madāʾ in," *Sumer* 23, 1967, pp. 3ff.), and the reportedly round city of Sasanian Isfahan is not yet uncovered. Ardašīr-ḵorra may have influenced the layout of later circular cities such as al-Manṣūr's Baghdad and its successors.

Few details are known about the architectural and sociological structure of orthogonal cities such as Jondīšāpūr (R. McC. Adams and D. Hansen, "Archaeological Reconnaissance and Soundings in Jundi Shapur," *Ars Orientalis* 7, 1968, pp. 53ff.), Ayvān-e Karḵa, and Bīšāpūr, the last featuring a commemorative monument at the intersection of its two orthogonal main axes (Ghirshman, *Bîchâpour* I, pp. 21ff.; II, plan I). The majority of cities certainly continued older settlements with regular or organically grown patterns, as at Eṣṭaḵr (D. Whitcomb, "The City of Istakhr and the Marvdasht Plain," In *Akten des VII. internationalen Kongresses für iranische Kunst and Archäologie, München, 7.-10. September 1976*, Berlin, 1979, pp. 363ff.). Some residential areas have been surveyed or excavated in Kīš (S. Langdon, "Excavations at Kish and Barghutiat 1933," *Iraq* 1, 1934, p. 113), Ctesiphon (Kühnel, *2. Ktesiphon-Expedition*, pp. 1ff.; R. Venco Ricciardi, "The Excavations at Choche," *Mesopotamia* 3-4, 1968/69, p.57; idem, "Trial Trench at Tell Baruda," *Mesopotamia* 12, 1977, pp. 11ff.), Lorestān (Morgan, op. cit., pp. 361ff.), Roqbat al-Madāʾen (Finster-Schmidt, op. cit., pp. 151ff.) and Qaṣr-e Abū Naṣr (W. Hauser and J. M. Upton, "The Persian Expedition 1933-34," *Bulletin of The Metropolitan Museum of Art* 29, December 1934/II, pp. 3ff.), but the daily life of the middle and lower classes remains incompletely known.

(d) *Fortifications*. The main elements include ditches, walls with stepped

niches, blind windows and arrow slots with horizontal or triangular covering, stepped battlements, corridors or narrow rooms within the walls, and far-protruding bastions, generally with semicircular headings. Unsophisticated gates were placed between pronounced bastions, and gate chambers were connected with the defense platform above by vertical shafts, probably for acoustic communication.

Few city ramparts have survived later changes. Ardašīr-ḵorra clearly had an earth wall with bastions, a ditch, and a small fore-wall. The ramparts of Bīšāpūr were originally lined with semicircular bastions about 40 cm apart (ʿA. A. Sarfarāz, "Bīšāpūr, the Great City of the Sasanians" [in Persian], *Bastan Chenassi va Honar-e Iran* 2, 1969, pp. 27ff.). The presumed palace section of the ramparts of Ayvān-e Karḵa shows an elaborate arrangement of brick constructions (Ghirshman, *MDAFI*, 1952, pp. 10ff.). The brick wall of Dastegerd, an unusual 16.6 m thick, harbored narrow corridors with radiating arrow slots and connecting semicircular tower chambers (F. Sarre and E. Herzfeld, *Archäologische Reise im Euphrat- und Tigris-Gebiet* II, Berlin, 1920, pp. 76; IV, pl. 127). The exceptional cut stone facing of the wall at Taḵt-e Solaymān (Osten-Naumann, op. cit., p. 39) seems to be identical with that of the Darband walls (S. Khan-Magomedov, *Derbent*, Moscow, 1979). The standard Sasanian fortification type is represented by the mud brick ramparts of Ctesiphon and Eṣṭaḵr (M. M. Negroponzi and M. C. Cavallero, "The Excavations at Choche," *Mesopotamia* 2, 1967, pp. 41ff.; Herzfeld, *Iran in the Ancient East*, pp. 276ff.) and by the rubble stone walls of Qaḷʿa-ye Doḵtar at Fīrūzābād (Huff, *AMI* 11, 1976, pp. 138ff.).

Most surviving fortresses served as isolated strongholds or protection for cities; this abundant but scarcely explored military architecture gives some insight into the Sasanian social hierarchy. Examples of the regular, generally square, Roman-type fort with rounded bastions are found in Harsin, Qaṣr-e Šīrīn (Morgan, op. cit., pp. 354ff.), Sīrāf (D. Whitehouse, "Excavations at Siraf," *Iran* 10, 1972, pp. 63ff.), and at several Mesopotamian sites (Finster-Schmidt, op. cit., pp. 49ff.). More frequent are irregular fortresses on strategically important heights; these usually have straight curtains between rounded bastions, as at Fīrūzābād, Bīšāpūr, Tūrang Tepe (R. Boucharlat, "La forteresse sassanide de Tureng-Tepe," in *Colloques internationaux du C. N. R. S.*, No. 567: *Le plateau iranien et l'Asie Centrale des origines à la conquête islamique*, Paris, 1977, pp. 329ff.), and the "Ātašgāh" at Isfahan (M. Siroux, " " Atesh-gâh" près d' Ispahân," *Iranica Antiqua* 5, 1965, pp. 39ff.). Territorial defense lines are

known from literary tradition and archeological evidence (R. N. Frye, "The Sasanian System of Walls for Defense," in M. Rosen-Ayalon, ed., *Studies in Memory of Gaston Wiet*, Jerusalem, 1977, pp. 7ff.), such as the ditch of Šāpūr II west of the Euphrates, the limes of Sīstān (A. Stein *Innermost Asia* II, Oxford, 1928, pp. 972ff.), the walls of Darband from the Caspian into the Caucasus (A. A. Kudryavtsev, "O datirovke pervykh sasanidskikh ukrepleniĭ v Derbente," *Sovetskaya Arkheologiya* 3, 1978, pp. 243ff.), the wall of Tammisha (Tamīša) from the bay of Gorgān/Astarābād to the Elburz (A.D. H. Bivar and G. Fehérvári, "The Walls of Temisha," *Iran* 4, 1966, pp. 35ff.), and the wall of Alexander north of the Gorgān river, although the last may date back to Parthian times (D. Huff, "Zur Datierung des Alexanderwalls," *Iranica Antiqua* 16, 1981, pp. 125ff.; M. Y. Kiani, *Parthian Sites in Hyrkania*, AMI, Ergänzungsband 9, Berlin, 1982, pp. 11ff.).

(e) *Funerary, commemorative, and rock architecture*. The remarkable lack of monumental funeral architecture may be explained by Zoroastrian religious prescriptions (*Vd.* 6.44ff.) restricting burial rites to exposure of the dead and a possible but not necessary preservation of the bones in bone receptacles, or *astōdān*s. Rock-cut exposure platforms and small cavities for preserving the bones are known mainly from southern Iran, notably around Eṣṭaḵr and Bīšāpūr, where the huge grotto with the statue of Šāpūr I is interpreted as his tomb (Vanden Berghe, *Archéologie de l'Iran ancien*, p. 45; A. Stein, *Old Routes of Western Iran*, London, 1940, pp. 311ff.; Ghirshman, *Bîchâpour* I, pp. 180ff.). Ritual texts describe *astōdān*s as freestanding buildings, a type possibly represented by a bone burial in a fortification tower in Šahr-e Qūmes (J. Hansman and D. Stronach, "A Sasanian Repository at Shahr-i Qūmis," *JRAS*, 1970, pp. 142ff.) and by the tower of Nūrābād (D. Huff, "Nurabad, Dum-i Mill," *AMI*, N.F. 8, 1975, pp. 167ff.). Rock-cut tombs on the island of Ḵārg seem to belong at least partly to non-Zoroastrian communities (E. Haerinck, "Quelques monuments funéraires de 1'île de Kharg dans le Golfe Persique," *Iranica Antiqua* 11, 1975, pp. 134ff.).

Some commemorative or triumphal monuments are identified by inscriptions. The Syro-Roman-influenced twin-column monument in Bīšāpūr was dedicated to Šāpūr I (G. Salles and R. Ghirshman, "Châpour," *RAA* 10, 1936, pp. 117ff.). The tower-like monument of Pāykūlī celebrates the victory of Narseh over his rivals (E. Herzfeld, *Paikuli. Monument and Inscriptions of the Early History of the Sasanian Empire* I-II, Berlin, 1924). There is as yet no definitive explanation for the late Sasanian Ṭāq-e Gerra, a small *ayvān* building with a Syro-Roman

archivolt (H. V. Gall and W. Kleiss, “Entwicklung und Gestalt des Thrones im vorislamischen Iran,” *AMI*, N.F. 4, 1971, pp. 2ff.; S. Kambakhsh Fard, “L’arc de Guirra, monument en pierre,” *Traditions architecturales en Iran* 4, 1976, pp. 2ff.), or for a freestanding gateway building outside the wall of Bīšāpūr (Sarfarāz, op. cit., pp. 27, 73). The tower in the center of Ardašīr-ḵorra, which possibly carried a hall with the king’s seat or his fire, may symbolize God-given royalty (Huff, *Istanbuler Mitteilungen* l9-20, 1969/70, pp. 319ff.). The late Sasanian Ṭāq-e Bostān, an *ayvān*-like artificial grotto, is linked by its monumentality with official Sasanian architecture, and by its decoration with the tradition of Sasanian rock reliefs (E. Herzfeld, *Am Tor von Asien*, Berlin, 1920, pp. 57ff.; M. C. Mackintosh, “Taq-i Bustan and Byzantine Art,” *Iranica Antiqua* 13, 1978, pp. 149ff.; S. Fukai et al., *Taq-i Bustan* I-IV, Tokyo, 1968-84). It may be related to other, partly unfinished rock monuments, such as those at Bīsotūn (H. Luschey, “Bisotun, Geschichte und Forschungsgeschichte,” *Archäologischer Anzeiger*, 1974, pp. 114ff.; W. Salzmann, “Die Felsbearbeitung und Terrasse des Farhad in Bisotun,” ibid., 1976, pp. 110ff.) and Harsin (Godard, *Athar-é Iran* 3, 1938, pp. 67ff.).

(f) *Civil engineering architecture*. The centralized Sasanian government enabled the realization of large-scale community projects such as road communications, bridges, irrigation, and drainage systems, most of which utilized the technical skill and manpower of Roman prisoners of war. Many bridges (e.g. Ḵūzestān and Lorestān, Fīrūzābād, Bīšāpūr, and Bīsotūn) show Roman-style dressed masonry with iron clamps at their preserved piers, which are generally rectangular with a triangular prism upstream; the arched superstructures are mostly destroyed (Stein, op. cit., pp. 15, 48, 71). Bridges were frequently constructed as weirs for irrigation and constituted the starting point of far-reaching canal systems, as at Šūštar and Dezfūl (Dieulafoy, V, pp. 105ff.; G. Van Roggen, “Notices sur les anciens travaux hydrauliques en Susiane,” *MDAFI* 7, 1905, pp. 167ff.; R. J. Wenke, “Imperial Investments and Agricultural Developments in Parthian and Sasanian Khuzistan: 150 B.C. to A.D. 640,” *Mesopotamia* 10/11, 1975/76, pp. 31ff.). Aqueducts were carried on walls or bridges, and the use of syphon tunnels seems to have been known (Adams-Hansen, op. cit., pp. 59ff.).

# BIBLIOGRAPHY

Given in the text.