Chapter 5
The Roman World

During the first millennium BCE, while Greek civilization originated and flourished on the mainland and around the eastern Mediterranean, an enigmatic people, the Etruscans, were settling and developing their own culture in the area of north-central Italy now known as Tuscany. The origins of the Etruscans are not precisely understood; they are thought to have migrated onto the Italian peninsula from Asia Minor ca. 1200 BCE, after the collapse of Hittite power. From surviving inscriptions, art, artifacts, and architecture, it seems that the Etruscans drew on diverse roots. Greece during its early and Classical eras was a particularly strong influence, but there were other cultural connections as well. The Etruscans' language contained both Indo-European and non-Indo-European elements and was written in a script derived directly from Greek; their religion, which placed great emphasis on providing worldly goods for the afterlife, had much in common with that of Egypt. With that of the Hittites their art shares relief carvings of protective beasts at tomb entrances, and with the art of the Minoans and Mycenaeans naturalistic decorations depicting birds and dolphins. The Etruscan practice of reading omens from the entrails of animals follows that of Babylonia and Assyria, and their use of the arch and vault in monumental gateways indicates links with the architecture of Asia Minor. Even though they assimilated much from their neighbors, the Etruscans were an original people whose accomplishments left distinctive imprints on Roman civilization.

ETRUSCAN IMPRINTS

Our understanding of the Etruscans is limited by the dearth of textual records. Funerary inscriptions comprise the bulk of surviving written documentation, and although these can be deciphered with reasonable accuracy, they tell us little about the language or Etruscan society and how it functioned. Etruscan settlements appear to have been loosely organized into autonomous city-states rather like those in Mesopotamia and Greece, and the Etruscan economy was based on agriculture and international trade, especially in metals: tin was imported from Britain, silver from Spain, and iron and copper were widely available. Etruscan culture was well established by the eighth century BCE and grew in influence for the next 200 years to encompass the area from the river Po in northern Italy to the region around Pompeii, south of Rome. One of their cities, Marzabotto near Bologna, had a grid plan, with the main streets running perpendicular to one another and intersecting in the center of town (Fig. 5.1). The Romans, who would use similar plans for their military camps (**castra**), labeled the main north–south street the **cardo** and the east–west route the **decumanus**. The orthogonal plan may have owed something to colonial Greek cities, known through trade.

It seems clear that the Etruscans borrowed the orders of architecture and the temple form from Greece, modifying both to suit their own purposes. Greek temples generally had a continuous colonnade surrounding the sanctuary at the center, with entrances on both gabled ends. In contrast, Etruscan temples typically contained a tripartite, or three-part, cella oriented in only one direction, generally to the south (Fig. 5.2). The temple was set on a high podium, covered with a gable roof, and approached through a double

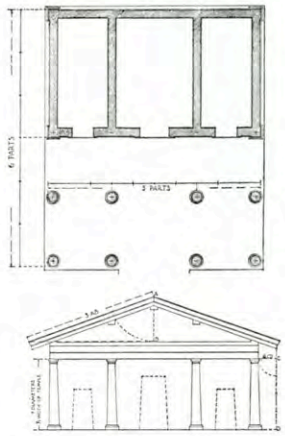
Maison Carrée, Nîmes, France, 1–10 CE.
Located far from Rome, this is one of the best preserved temples of antiquity. Thomas Jefferson so admired it that he used it as the model for his design of the Virginia State Capitol in Richmond. The designer of the Maison Carrée employed the Corinthian order, freestanding at the front porch and attached as half columns around the cella. In ancient Roman times the temple stood within a forum.

Chronology

Height of power of the Etruscan civilization	550 BCE
The Roman Republic	509–27 BCE
Dictatorship of Julius Caesar	46–44 BCE
Reign of Caesar Augustus and beginning of the Roman Empire	27 BCE–14 CE
Vitruvius writes *De architectura*	ca. 27 BCE
Reign of Nero	54–68 CE
Reign of Vespasian	69–79
Construction of the Colosseum	completed 80
Reign of Domitian	81–96
Reign of Trajan	98–117
Reign of Hadrian	117–138
Construction of the Pantheon	ca. 125
Reign of Septimus Severus	193–211
Reign of Diocletian	284–305
Reign of Constantine	310–337

5.1 Plan of Marzabotto, ca. 2nd century BCE.
This plan shows a grid of blocks. Excavations of building foundations are shown in the same areas. The acropolis lies on the northwestern corner of the site, while the River Reno runs along the southern edge. The cardo is the Roman name for the primary north–south street and decumanus for the primary east–west street.

5.2 Drawing of an Etruscan temple, based on descriptions by Vitruvius.
Compare this plan to those of Greek temples (see Figs. 2.14–2.16). Note that the colonnades extend only across the front to create a portico, while the cella has been expanded to several chambers set the full width of the temple. The highly sculptural building of the Greeks, meant in Classical times to be viewed at an angle, has been transformed into one dominated by a central axis and meant to be seen frontally.



row of columns set at the top of a single flight of stairs. The intricate refinement of the Doric and Ionic was forsaken for a greatly simplified original order, the **Tuscan**, which had the basic characteristics of the Doric but no fluting on the column shafts or sculpture on the frieze. Intercolumnar spacing on Etruscan temples was markedly wider, the roof pitch considerably lower, and the eave overhang greater than on Greek temples, creating a broadly horizontal emphasis. Both the columns and roof structure were built of wood, while the walls were laid up with unbaked brick. More durable terracotta was employed for roofing tiles, pediment ornamentation, and sculpture.

Because of the impermanence of their materials, no Etruscan temples survive, although literary and archaeological sources provide adequate evidence of their form and terracotta elements preserve decorative features. Architectural remains are scarce, and much of what is known about residential designs has been deduced from tomb architecture and funerary urns made in the shape of miniature dwellings. Tomb excavations at Cerveteri provide clues about upper-class housing. The rooms, hollowed out of easily carved volcanic rock (tufa), are entered through a vestibule and grouped around an inner court, which suggests an **atrium**. In some tombs, the architectural features of doors, roof beams, and moldings have been reproduced, and furnishings, such as chairs, cooking utensils, and other household items, are likewise carved in stone.

At Perugia, which was the Etruscan city of Perusia, there still exists a monumental gateway (the so-called Arch of Augustus) displaying Etruscan influence, although it dates from after the fall of Perugia to the Romans in 310 BCE (Fig. 5.3). Above the double row of voussoirs, or wedge-shaped stones, forming the gateway arch is a decorative motif consisting of metopes and triglyphs similar to a Doric frieze. Circular shields fill the spaces of the metopes, and the triglyphs are actually short fluted pilasters with volutes at the top. A relieving arch flanked by Ionic pilasters is set atop the band of Doric-inspired ornament. In borrowing here from the Greeks, the Etruscans used elements of the orders with originality, if not with understanding. Later the Romans would forge a coherent and powerful architectural style of their own by employing the arch and vault for structure and using the orders largely as decoration.

The Etruscans, together with native Italian peoples, the Latins and the Sabines, inhabited the hills that rose above the marshlands on either side of the river Tiber. Etruscan builders began to drain the marshes by digging the trench that later became the Cloaca Maxima, the major sewer of ancient Rome. According to legend, the city of Rome was founded on these hills in 753 BCE by Romulus and Remus, and it was ruled from 616 to 510 BCE by members of the Etruscan royal house, the Tarquins. In about 500 BCE, the Latins overthrew the Tarquins and established the Roman Republic. The expulsion of Etruscan rulers from Rome did not signal their complete disappearance from Italy, however; other Etruscan city-states to the north continued to

5.3 Semicircular "Arch of Augustus," Perugia, after 310 BCE.
The lower portions were constructed by the Etruscans. The Romans later exploited the structural possibilities of the semicircular arch in their buildings.

thrive even as Roman authority was growing. From 396 to 88 BCE Roman forces gradually incorporated these northern settlements, but not before many aspects of their culture had merged into Roman life. Etruscan art and architecture influenced Roman work, and Etruscan customs, such as chariot racing and bloody gladiatorial contests, were also popular in Roman society.

THE ROMANS

The beginning of Roman civilization was contemporary with that of the Greeks, the Etruscans, and the later Egyptian dynasties. Unlike all of these other cultures, however, Rome continued to grow in importance as the first millennium BCE waned, reaching its apogee in the first and second centuries CE. In time Rome absorbed the Etruscans, Greeks, Egyptians, and many lesser peoples and formed an empire with a remarkably homogeneous architectural style. Roman building practices, like Roman culture, were derived from many sources, especially Etruscan and Greek, but the forms of their architecture were in many respects original.

The ancient Romans were certainly materialistic, but also very practical. Their society is often depicted in popular culture as excessively brutal, particularly regarding its fixation with the slaughter of animals and people in the Colosseum and lesser amphitheaters and its use of crucifixion as a means of capital punishment. The Romans, however, must be judged within the context of their age and locale, one when and where slave holding, the wholesale slaughter of civilians by invading armies, and savage punishment, including crucifixion, meted out by the prevailing justice systems, were common in adjacent cultures as well. As a counterpoint, the Romans were strongly devoted to family life, astute lawmakers, gifted administrators, and, most importantly for us, highly competent and innovative builders.

Their architecture changed significantly, however, as their political system changed. The city of Rome first became the seat of a republic governed by a senate with members drawn from notable families and by elected magistrates or consuls. As the Roman armies conquered more and more of Italy and beyond, the populace struggled to maintain a governmental system that could administer efficiently and that could satisfy both the landed aristocracy (patricians)

5.4 Pont du Gard, Nîmes, 20–16 BCE. The water channel (aqueduct) runs along the uppermost level, which maintains a constant incline to carry the water, through the pull of gravity, from nearby mountains into the city of Nîmes. Aqueducts ran along the contours of the land whenever possible, but when a valley had to be crossed, as here, Roman engineers used arches to span the gap. Projecting stones and inset holes were used for bracing the wooden centering, or scaffolds, needed to erect the arches, and they were left in the finished work in case repairs were ever required. This aqueduct has long been severed, so the Pont du Gard no longer carries water.

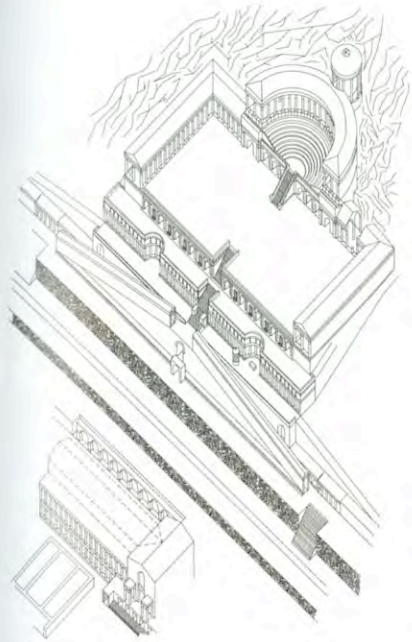
and the general class of free citizens (plebs). A crisis eventually arose in the first century BCE that resulted in the assumption of dictatorial power by the military leader Julius Caesar. Although he was assassinated, his rule ushered in the Roman Empire and a succession of emperors beginning with Augustus Caesar in 27 BCE. The breadth and complexity of the Empire demanded new construction practices capable of producing very large buildings relatively quickly and economically. It is the architecture of the Empire on which this chapter will concentrate.

We are aided (and sometimes slightly amused or bewildered) in our understanding of Roman construction during the time of the Republic by a contemporary work, *The Ten Books of Architecture*, composed in the late first century BCE by Marcus Vitruvius Pollio, commonly known as Vitruvius, who dedicated his book to Emperor Augustus. As literature, his book is not a masterpiece. Like many architects since, Vitruvius was not particularly skilled as an author, and the precise meaning of some of his writing is difficult to deduce. Based in part on Greek precursors, his text was doubtless not the only one of its kind, but it is the only intact treatise on architecture to have survived from antiquity, and as such it has been studied carefully by architects from the Renaissance to the present seeking to understand the principles of Roman architecture. Among the topics Vitruvius covers are building design, city planning, military engineering, and the design of machines, which together indicate that architects dealt with a much wider array of problems in design and construction then than they do now. His opening comments on the education of the architect are enlightening:

> *The architect should be equipped with knowledge of many branches of study and varied kinds of learning, for it is by his judgment that all work done by the other arts is put to the test. This knowledge is the child of practice and theory. Practice is the continuous and regular exercise of employment where manual work is done with any necessary material according to the design of a drawing. Theory, on the other hand, is the ability to demonstrate and explain the productions of dexterity on the principles of proportion. It follows, therefore, that architects who have aimed at acquiring manual skill without scholarship have never been able to reach a position of authority to correspond with their pains, while those who relied only upon theories and scholarship were obviously hunting the shadow, not the substance. But those who have a thorough knowledge of both, like men armed at all points, have sooner attained their object and carried authority with them.*

BUILDING TECHNIQUES AND MATERIALS

The Romans compartmentalized their activities and were able to build large interior as well as exterior spaces to hold them. The imposing quality and size of their construction is a result of their application of engineering skills to the problems they encountered in everyday life. Roman construction exploited structural elements that acted in compression: the arch, the vault, and the dome, elements developed by earlier civilizations but used in a very limited fashion (see Fig. 0.5). In Roman hands these



5.5 Axonometric drawing of the Sanctuary of Fortuna Primigenia, Praeneste, ca. 80 BCE. Compare this multi-level architectural ensemble to the Greek Hellenistic Sanctuary of Asklepios on the island of Kos, as seen in Fig. 2.33. The ancient Greeks had, in turn, been influenced by such Middle Kingdom Egyptian site developments as the Temple of Queen Hatshepsut, seen in Figs. 1.29 and 1.30.

elements became the basis for structural systems on a scale unimaginable with post-and-lintel construction.

A true arch consists of voussoirs set in a curved shape, often a semicircle. Building one requires a temporary timber formwork, or centering, to support the voussoirs as they are laid, for the arch will not stand on its own until all the voussoirs, including the central **keystone**, are set in place. (Contrast this true-arch construction to the technique of corbeling, where each course rests on and overhangs the preceding one (see Fig. 2.9). No centering is required, for the construction is always stable, but the form produced is not a true arch.) If the arch is continued along its longitudinal axis, it produces a vault; if an arch is rotated on its center, it produces a dome. By using arches, vaults, and domes, the Romans could enclose large areas using modestly sized stones cut carefully to shape. The space between supports, necessarily severely limited when stone lintels are used because stone in tension tends to crack over wide spans, could now be made much larger because vaulted construction carries the structural load almost completely in compression, for which stone is well suited. There is a price for this stability. The weight of the masonry in vaulted construction pushes not only downward but also outward on the supports on which it rests, and this outward thrust must be countered by dead weight. So vaulted construction requires walls or piers that are much thicker than those used in post-and-lintel buildings.

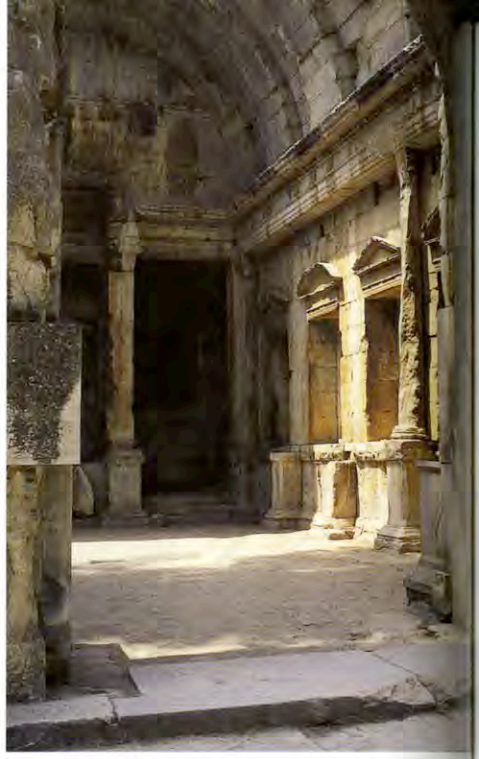
The earliest Roman vaults were built for utilitarian structures. Mention has already been made of the Cloaca Maxima, the trench begun by the Etruscans to drain the Roman marshes. By the mid-first century BCE, it was vaulted with stone, and the construction still functions as one of the main sewers of Rome. Discharging wastes into the Tiber, however, made the river water unfit for human consumption, so clean water was brought from rivers or springs in the Sabine Hills above Rome, piped in a gravity-fed system of **aqueducts** to city reservoirs, then distributed to fountains or other uses around the city. As much as possible, the water channel or aqueduct followed the contour of the land, but where it had to cross valleys, it became necessary to elevate the conduit in order to preserve the constant slope of the supply line. The Romans erected handsome arched structures for this purpose. They completed the Aqua Appia in 312 BCE and constructed three more aqueducts in the second half of the second century BCE to provide water for the growing population of Rome. They added the impressive Aqua Claudia in 38 CE to bring water from Tivoli, some forty-five miles away. This aqueduct's great masonry arches, some more than 100 feet high, extended over the countryside for much of that distance.

Perhaps the most spectacular surviving aqueduct span is the Pont du Gard (20–16 BCE) outside Nîmes in southern France (Fig. 5.4). Made of unmortared masonry (**opus quadratum**), the aqueduct strides 882 feet over the valley of the river Gard on three tiers of arches, carrying the water channel 160 feet above the level of the river. Its design is remarkably straightforward: the two lowest arch levels are identical rows of semicircular arches, sixty feet in diameter except for the span across the river, which is eighty feet. The uppermost tier has arches set on twenty-foot centers, so that a unifying rhythm ties all three levels together. Projecting stones used for support of the centering and scaffolding add surface texture, and they were retained in case repairs were ever needed. Enclosed above the highest arches is the water channel, about six feet square in cross-section, lined with mortar to prevent leaks. A roadway is carried above the lowest row of arches.

A dramatic example of Roman construction from the time of Vitruvius's childhood and one strongly influenced by Hellenistic Greek practices is the upper portion of the Sanctuary of Fortuna Primigenia (ca. 80 BCE) in Praeneste (modern-day Palestrina) near Rome (Fig. 5.5). In order to appreciate its organization, we must remember that the Hellenistic Greeks used stoas, bent and folded stoas, gateways, terraces, and stairs (see Kos, Fig. 2.33) to create architectural environments into which they inserted freestanding buildings. The Romans adopted this design strategy at Praeneste and elsewhere during the time of the Republic.

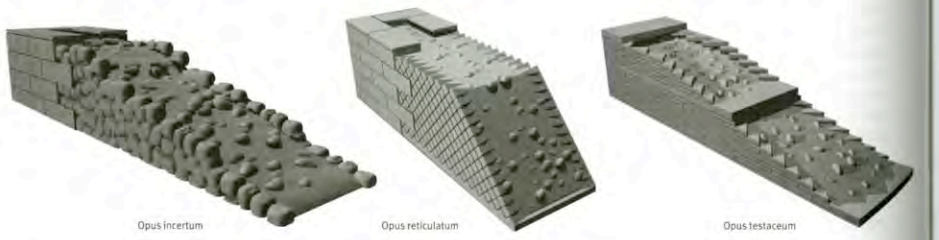
The complex is built into a steep hillside and culminates at the top with a small, circular, Corinthian temple housing the statue of Fortuna Primigenia. From the town below, ancient Roman visitors to the sanctuary would have proceeded up one of the longitudinally oriented stairs located to each side, moving, in effect, through an **opus incertum** retaining wall and toward colonnades shielding wells. At the top of these stairs, they would have turned 90 degrees left or right and moved toward the center by way of long, roofed-over ramps. At the top of the ramps and now on the centerline of the complex, they would again have moved longitudinally up a stair flanked by stoalike files of attached Ionic columns and two Ionic **hemicycles** that concealed **barrel-vaulted** compartments housing shops and acting together as a retaining wall. Atop the roof of these trabeated-arcuated shops, they would again have climbed a central, longitudinal stair flanked by more applied trabeation concealing more vaulted, retaining-wall shop compartments and ascended to a rectangular **forum** surrounded on three sides by a folded Corinthian stoa. Here they would have seen in front of them arches with applied trabeation astride another centrally located stair, this one leading up to a theater surrounded by yet another stoa, this one bent into a semicircle and serving as a final transitional experience to the circular temple. The sanctuary is in all respects a unified creation, whether seen from below along its central, longitudinal axis or experienced through time as a number of separate but related architectural incidents. While much of the original applied trabeation has been lost and the theater level has been enclosed to include flanking buildings, a visitor to Palestrina can still grasp the intended effects of this Romano-Hellenistic building ensemble.

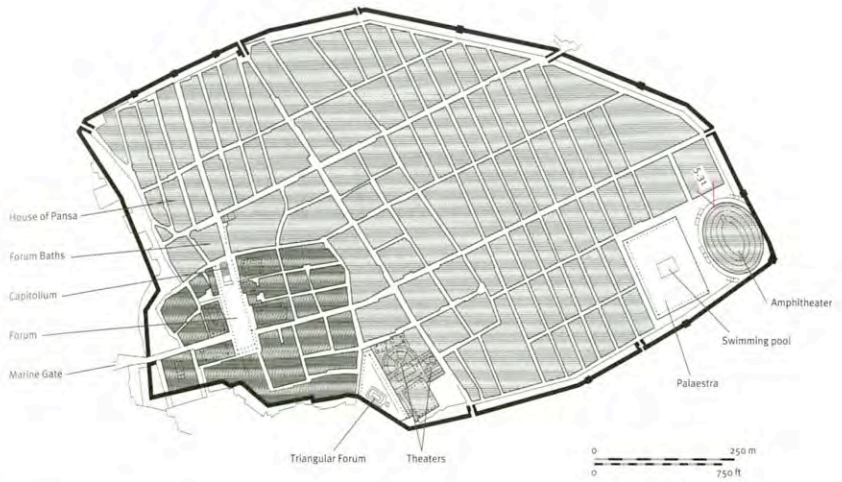
In Nîmes itself, the so-called Temple of Diana (ca. 80 CE) uses a distinctive barrel vault of ashlar, or cut-stone, masonry to create its principal interior space (Fig. 5.6). This masonry is unusual, however, for the technique was costly and required highly skilled stonecarvers. The efficient Romans developed a more expedient building method by using a new material, hydraulic **cement**, derived from volcanic deposits first discovered around Puteoli (today's Pozzuoli) and named **pozzolana**. Vitruvius described it as "a kind of natural powder which from natural causes



5.6 "Temple of Diana," Nîmes, ca. 80 CE.
This is a fine example of barrel-vaulted masonry construction used to enclose space. Note the ribs of the vault and the use of alternating triangular and segmental arched pediments above blind windows to articulate the wall.

5.7 Ancient Roman concrete wall construction.
By the time the Emperor Hadrian built his sprawling villa (Figs. 5.41–5.42), Roman engineers had perfected the masonry-wall-construction process, using "formwork" made from two faces of stone or tiles, with the cavity between them filled with concrete. From left to right, this facing changes from uncoursed rubble masonry, to pyramid-shaped stones, to pie-shaped tiles that appear as elongated brick in the laid-up walls in Fig. 5.38.





5.8 Plan of Pompeii, founded 6th century BCE.
This city dates back to a Greek colonial settlement, later occupied by the Etruscans and Samnites. During the Roman period, Pompeii was greatly enlarged to the outlines seen here. The forum is the major civic space in the original settlement, while recreational facilities are located in the southeast corner.

produces astonishing results." What the Romans discovered was that when pozzolana was mixed with lime, rubble, and water, the mixture reacts chemically and hardens to a stonelike consistency, even if under water. The simple lime mortars known to the ancients had some bonding strength, but they were ineffective for the bridge and harbor foundations where Roman builders first exploited the superior strength of pozzolana.

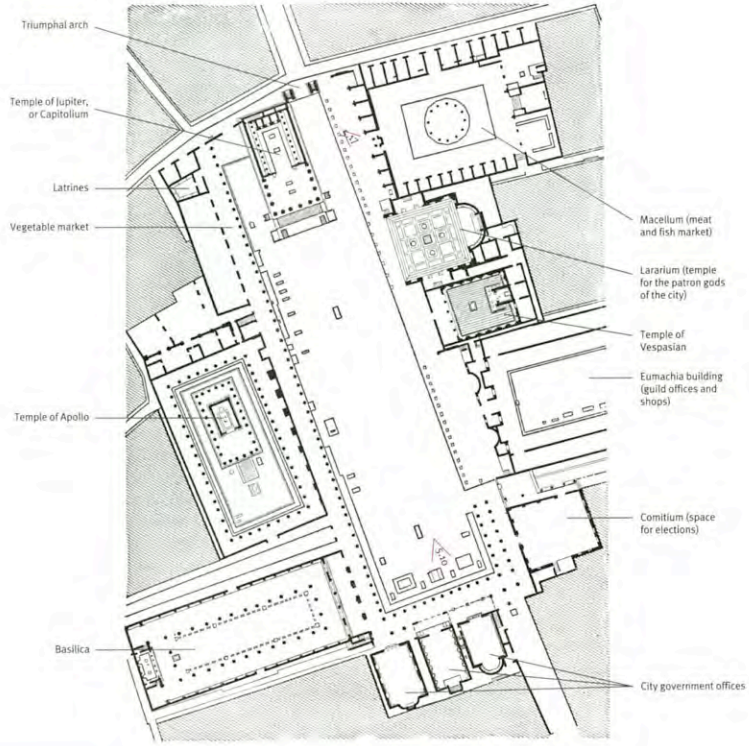
The Romans also found uses for this artificial stone away from the water. The new material made curves and irregular shapes much easier to achieve but the resulting walls were generally not as handsome as ashlar stone ones, so the Romans became adept at applying nonstructural wall finishes such as stucco, mosaic tiles, and marble veneer.

Today, because most Roman buildings have lost their finish surfaces, one can see the underlying construction in a way that Roman builders never intended. Early concrete walls were composed of rough stones surrounding a concrete core (**opus incertum**) (see Fig. 5.35), a technique later refined to pyramidal stones (**opus reticulatum**) (Fig. 5.7 and see Fig. 5.10) with square faces and their points embedded in the wall, which gave a more orderly exterior appearance. In imperial times (after 37 BCE) the Romans increasingly used triangular bricks as the concrete facing (**opus testaceum**) (see Figs. 5.37 and 5.38), laying their thin triangular shapes to present a smooth exterior and an irregular inner face for maximum bonding surface with the soupy cement mixture. (Stamps impressed on the wet bricks in the factory have enabled archaeologists to date many Roman structures with reasonable precision.) After the second century CE concrete walls with stone rubble striped by horizontal courses of brick bonding every three or four feet (**opus listatum**) became common, the brick courses also serving as a leveling device to keep the work plumb and true. The strength, durability, and economy of concrete construction gave the Romans a versatile material for large-scale building, and by the middle of the first century CE they were using it with rapidly increasing architectural sophistication.

CITY PLANNING

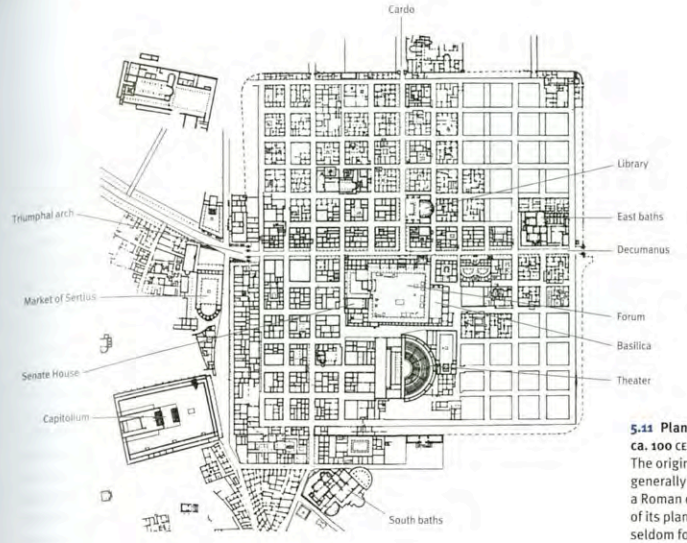
City planning practices in ancient Greece and in Rome had striking parallels. Both Athens and Rome, the cultural centers, grew without preconceived overall plans, while the colonial cities established by each were generally provided with orthogonal plans. Greek foundations might become Roman settlements later, as was the case with Pompeii, one of the best-preserved examples of a Roman provincial town owing to its burial in the eruption of Mount Vesuvius in 79 CE. The fabric of the city, already shaken by an earthquake in 62 CE, was engulfed by ash, lava, and mud that preserved it until excavations begun in 1748 brought the remains to light.

Pompeii was founded by the Greeks in the sixth century BCE, and it was briefly inhabited by the Etruscans and Samnites before becoming a Roman city. At the time of its destruction, it had a population of about 20,000, including great patrician families, middle-class merchants, retired persons, and slaves. Its irregular grid plan covered about 160 acres within roughly oval town walls (Fig. 5.8). The Roman civic center or forum was located in the southwest quarter, near the Marine Gate entrance (Fig. 5.9). The earlier Greek center was two blocks to the east, on an acropolis



5.9 Plan of the forum, Pompeii, founded 6th century BCE.
The various buildings flanking the open space were unified with colonnades. When Vesuvius last erupted in 79 CE, the city was still being rebuilt after suffering earthquake damage in 62 CE.

5.10 The forum looking north, Pompeii, founded 6th century BCE.
Reconstructed remains of the colonnades can be seen to both sides. At the far end of the forum, the column stumps of the Capitolium rise up, and to their right is the city's triumphal arch. The square ends of opus reticulatum units appear on the face of the masonry mass in the foreground.



5.11 Plan of Timgad, Algeria, founded ca. 100 CE.
The original gridded layout of Timgad is generally cited as the textbook example of a Roman city because of the great regularity of its plan. It is in fact orthogonal to a degree seldom found in Roman colonial cities.

with a Doric temple and a columned portico dating from the second or third century BCE. Streets ran approximately parallel and perpendicular to the forum, their pattern being adjusted to the varying topography.

Public facilities were dispersed around the town. Within the town walls, there were three baths, a large exercise facility (the **palaestra**) with a swimming pool, covered and open-air theaters, and an **amphitheater** capable of seating the entire population. Nine temples dedicated to various gods—Greek divinities, Roman deities, deceased Roman emperors, patrons of the city, and the oriental mystery cults of Isis and Bacchus—indicate the diversity of religious beliefs in Pompeii. Cemeteries were located outside the town gates.

The forum in Pompeii was the focus of public life (Figs. 5.9, 5.10). A two-story colonnade surrounded its rectangular form, 510 by 125 feet, on three sides, the open fourth (north) side being occupied by the Capitolium, the center for state-sponsored religious observances. A **triumphal arch** marked the north entrance and prevented wheeled vehicles from intruding on the pedestrian domain. Buildings of various designs and uses flanked the forum. On the east side were the macellum, the meat and fish market; the lararium, a temple for the patron gods of the city; the eumachia building, containing guild offices and shops of the cloth workers and dyers; and the comitium, an open area where elections were held. The short southern side contained three halls used for government: offices for judges and for public works officials and the council chamber. On the west side, bordered by the road from the Marine Gate, was the large **basilica** where public assemblies for legal, commercial, and social purposes were held. It functioned much as did the stoa in the Athenian Agora, yet the space here was enclosed and introverted. Beyond the basilica were the Temple of Apollo, which dated from the earliest period of Pompeii; the vegetable market, one of the last buildings constructed on the forum; and public latrines. Colonnades linking most of the buildings gave the forum architectural consistency (see Figs. 5.9 and 5.17). Conveying unity within such a diverse grouping of buildings constructed over three or more centuries is no insignificant accomplishment, and it indicates the high quality of Roman civic design attained even in provincial centers.

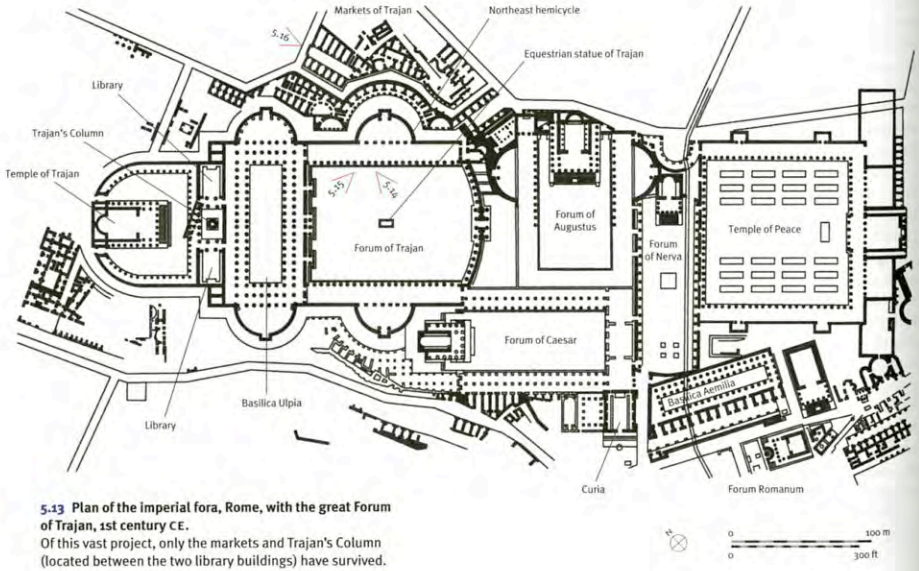
Some Roman cities began as military garrisons (castra) located in unsettled areas as a means of defense and of bringing civilization to new territories. For these, and for many colonial cities as well, the Romans had a standard plan, perhaps derived from the Etruscans and applied with consistency throughout their empire, from Britain to North Africa, Italy, and the eastern Mediterranean. It was rectangular or square, with two main roads, the cardo and the decumanus, crossing at right angles in the center of town. A wall surrounded it, and the public spaces—the forum and military headquarters—were usually located at the principal intersection in the center of town. Residential sectors were laid out in square or rectangular blocks, with land reserved for neighborhood markets and recreational facilities as the town grew. Streets could be numbered sequentially so that a stranger in town could find any given address easily. Large public buildings, such as baths and theaters, served the whole community and were located according to topography.

This standard Roman plan underlies many present-day European cities, including Florence and Bologna in Italy, Cirencester in England, and Trier in Germany. Timgad in Algeria is an original example that has not been overbuilt

5.12 View of the Forum Romanum, Rome.
This forum was largely transformed during the reign of Augustus (37 BCE–14 CE) to become a splendid civic center for Rome. Visible here (left to right) are three columns from the Temple of Vespasian, the Arch of Septimus Severus (203 CE), columns from the Temple of Saturn, and rows of column stumps from the Basilica Julia.

by a modern city, so its major features can be seen even though it is now a ruin (Fig. 5.11). Timgad was founded by the Emperor Trajan in 100 CE for veterans of the Roman legions and became a thriving regional center until it was destroyed by native tribes in the seventh century. The city walls enclosed a square, with the cardo and decumanus intersecting in the center of town. The forum is to the south, and a large theater was set just south of the forum. (Because of the theater's placement, the cardo did not continue through to the south.) Entrances into the city were framed by triumphal arches, and continuous colonnades lined the major streets to lend dignity and shelter to the sidewalks. Timgad had a population of perhaps 15,000 within a century of its founding, and in the third century CE it began to accumulate suburban developments along the approach roads to the north, west, and south. Large baths were built north and south of the walls, and markets and temples further served the expanding population outside the walls. None of the extramural growth conformed to the grid plan of the city proper.

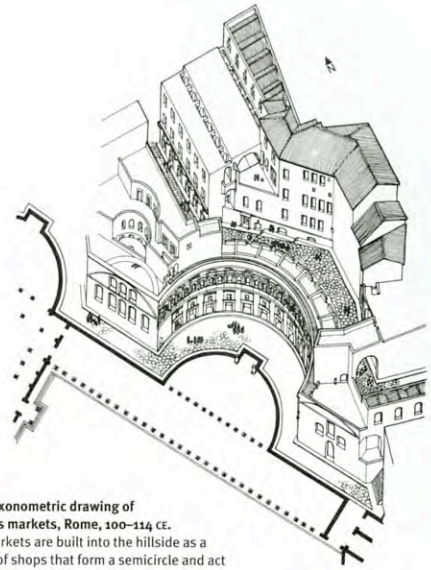
Trajan is also remembered for the substantial contributions he made to the urban fabric of Rome itself. Civic life in Rome focused on the Forum Romanum at the base of the Capitoline Hill in an area drained by the Cloaca



5.13 Plan of the imperial fora, Rome, with the great Forum of Trajan, 1st century CE.
Of this vast project, only the markets and Trajan's Column (located between the two library buildings) have survived.

Maxima (Fig. 5.12). Here the functions of commerce, government, law, and religion mingled, and with the growth of the city, the space became increasingly congested. From the middle of the first century BCE onward, the development expanded as new colonnaded fora were constructed adjacent to the original Forum Romanum (Fig. 5.13). Julius Caesar laid out a forum containing a temple and governmental chambers; Augustus constructed a forum at right angles to the Forum of Caesar to surround the Temple of Mars Ultor; and Vespasian built a forum around a library. The culmination of these constructions was the Forum of Trajan (ca. 100–14 CE), equal in size to all the others put together and built to the designs of Apollodorus of Damascus, who had served with distinction as a military engineer. The site was located north of the Forum of Augustus, where a ridge connecting the Capitoline and Quirinale hills was removed to provide a level area and improve access to all the fora from the north. Trajan's forum was symmetrically planned, with a monumental entranceway from the Forum of Augustus leading into the forum proper, a court 330 by 375 feet defined by double colonnades and semicircular elements (hemicycles) set on a cross-axis. Dominating the center of the court was a large equestrian statue of Trajan. Opposite the entrance was the Basilica Ulpia, a magnificent judicial building with entrances placed on its long side. Beyond the basilica was Trajan's Column, a marble shaft nearly 100 feet high set on a fifteen-foot-high base and carved with a spiraling narrative relief illustrating Trajan's victories in the Dacian Wars. Spoils from the Dacian campaign (in the region of present-day Romania) were used to finance the forum's construction. Trajan's Column, the sole surviving structure in this part of the forum, was flanked by two library buildings, one for Greek and one for Latin texts; the column's continuous frieze would have been readable from these neighboring buildings. At the terminus of the axis, in the center of a curving colonnaded courtyard, was a temple dedicated to Trajan and his wife by the later emperor Hadrian. Like those of Julius Caesar and Augustus, and like Etruscan temples, it has a deep porch with columns defining an entry space.

Needed commercial space adjacent to the forum was carved out of the Quirinale hillside behind the northeast hemicycle. Trajan's markets, a good part of which are extant, were set in a multi-story semicircle with adjoining, tiered buildings, reflecting the hemicycle of the forum below and becoming an arcaded complement to it (Figs. 5.14–5.15). The markets contained over 150 shops, offices, and a **groin-vaulted** market hall (Fig. 5.16), all of which could be reached from the forum and from streets on two higher levels. They were built of brick-faced concrete, a contrast to the marble and elaborate ornament of the forum. Durable barrel vaults provided the basic structural module both for the individual shops and for enclosed walkways between them. In the two-story market hall, piers rising from the walls between the shops to each



5.14 Axonometric drawing of Trajan's markets, Rome, 100–114 CE.
The markets are built into the hillside as a series of shops that form a semicircle and act as a retaining wall to hold back the earth in which they are embedded. At the top left, the vaulted market hall lies further up the hill.

5.15 Trajan's markets, Rome, 100–114 CE.
This view of the shops shows the great semicircle that completed one side of the principal cross-axis of the forum.

5.16 Covered market hall built by Trajan, Rome, ca. 100 CE. Constructed in concrete, this is an early example of a groin-vaulted space with clerestory lighting and flying buttresses (one of which is visible through the near-left-end bay at the upper level). It shows the care extended by Roman builders to civic structures accommodating such mundane activities as a fruit and vegetable market.

5.17 Triumphal arch, Pompeii, before 79 CE. Monuments such as these were the pride of the city, reflecting civic virtues and boldly marking entrances to important sites. In this case, the arch also restricted access of wheeled vehicles into the forum.

side of the central space support six groin vaults given lateral support by **flying buttresses**.

We have noted the presence of triumphal arches in both Pompeii (Fig. 5.17) and Timgad. These freestanding monuments were generally built to commemorate a military victory, and they added grandeur to the public realm by serving as reminders of civic greatness. Of surviving arches, those in Rome are the most elaborate. The Arch of Septimus Severus (203 CE) still stands in the Forum Romanum, while the larger Arch of Constantine (finished 315 CE) (Fig. 5.18) stands near the Colosseum. Both are triple-arched structures, the central arch being larger than the side arches, and the **attic** story (above the arch) is embellished with carved relief panels depicting the particular military victory for which the arch was constructed. Constantine's Arch incorporates panels from earlier monuments. As an architectural motif, the triumphal arch will have a long afterlife, being revived in **Carolingian**, Romanesque, Renaissance, and later works.

5.18 The Arch of Constantine, Rome, 315 CE. This triple-arched form became an architectural motif adapted to later buildings. Compare the abbey gatehouse at Lorsch (see Fig. 8.4) and the west front of S. Andrea in Mantua (see Fig. 11.16) for examples of later works inspired by this design.

ESSAY

The Engineering Might of the Romans

by Dan MacGilvray

5.19 Altar from Claudian period, 1st century CE. Villa Medici, Rome.

It now remains for us to speak of stones, or, in other words, the leading folly of the day . . . as to the mountains, nature has made those for herself, as a kind of bulwark for keeping together the bowels of the earth; as also for the purpose of curbing the violence of the rivers, of breaking the waves of the sea, and so, by opposing to them the very hardest of her materials, putting a check upon those elements which are never at rest. And yet we must hew down these mountains and carry them off . . . for no other reason than to gratify our luxurious inclinations. . . .

These very mountains are cut asunder to yield us a thousand different marbles, promontories are thrown open to the sea, and the face of nature is being everywhere reduced. . . . We now carry away the barriers that were destined for the separation of one nation from another; we construct ships for the transport of our marbles; and amid the waves . . . we convey the summits of the mountains to and fro: a thing, however, that is even less unpardonable than to . . . search amid the regions of the clouds for vessels with which to cool our draughts, and to excavate rocks, towering to the very heavens, in order that we may have the satisfaction of drinking from ice![1]

In these two paragraphs from his *Natural History*, Pliny neatly exposes both the arrogance and the capabilities of the Roman civilization. As opposed to the esthetically sensitive Greeks, the Romans were the mighty engineers of the ancient world, conquering not only all the peoples and nations of the Mediterranean, but subduing the sea itself and even the mountains that surround it.

Not since the Egyptians had architects and constructors had the routine capability of choosing building materials for their projects that came from great distances. Ancient buildings had always reflected the local geology: the sun-dried brick walls and vaults of Babylon were built of mud scooped from the Euphrates flood plain, the gleaming white Parthenon was constructed of marble from nearby Mount Pentelikos. Even the proud Egyptians were limited to materials found within the 600-mile-long watershed of the Nile below the first cataract—limestone for the pyramids came from the Giza plateau or Tura, across the river; sandstone for the temples at Luxor and Karnak was quarried at Silsileh, a few miles conveniently upstream. Only when they required the toughest of all stones, granite, for a 100-foot obelisk or to line the pharaoh's chamber in the Great Pyramid, were the Egyptians called upon to move their stones great distances.

In contrast, Roman architects routinely constructed concrete walls and vaults using pozzolana, a natural cement mined near Naples, and the emperors adorned their temples, palaces, and baths with a polychrome profusion of thin marble veneers and graceful columns: pure white from Carrara overlooking the Lingurian Sea above Pisa, or the island of Proconeseus in the Sea of Marmara; *giallo antico* (antique yellow) from Tunisia; *verde antico* (green) from Greece; onion-skinned *cipolino* from the Aegean isles; purple porphyry, rose and gray granite from Egypt. Romans outdid Egyptians by pulling down the great obelisks from their temple fronts, moving them on specially constructed ships over 1500 miles across the Mediterranean, and reerecting them in the circuses, villas, and gardens of Rome (Fig. 5.19). In the process they seem to have offended not only the Egyptian gods but also Pliny, who comments on Roman "folly" and environmental arrogance.

Just as the ancient Romans indelibly marked the mountains with their quarries, Rome today still displays some of its ancient arrogance (and capabilities) as granite obelisks, marble veneers, and slender columns have been relocated to adorn public places and the temples of the Catholic Church.

1 Plinius Secundus, C. (the Elder Pliny), *The Natural History of Pliny, Vol. VI*, translated by John Bostock and H.T. Riley (London: Henry G. Bohn, 1862), p. 305. Pliny is referring to quartz as the material that gives the "satisfaction of drinking from ice."

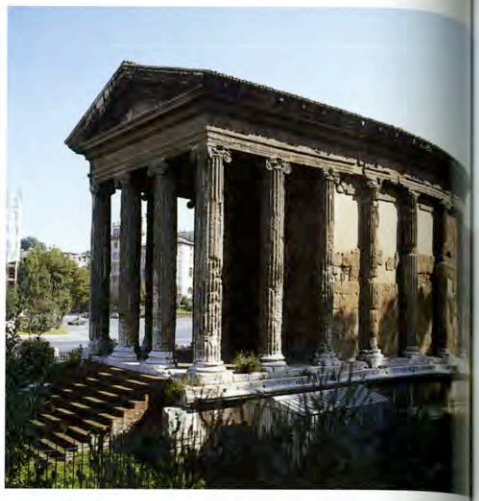
TEMPLES

Discussion of the Roman fora has indicated the locations of temples, which the Romans built largely on the basis of Greek and Etruscan precedents. Generally speaking, the Romans did not build temples as isolated structures as had the Classical Greeks, but as axially approached buildings in an urban setting, like the temples of the Hellenistic period or the temples of the Etruscans. The placement of the Capitolium in the forum at Pompeii and the Temple of Mars Ultor in the Forum of Augustus in Rome was essentially the same, and the temple designs were similar. Both were raised on podiums, so that a flight of steps led up to the colonnaded portico of the cella space.

As the Capitolium and the Temple of Mars Ultor are largely destroyed, smaller Roman temples that have survived more completely provide us with a better image of temple architecture. In Rome the second-century BCE Temple of Fortuna Virilis (Fig. 5.20) superficially resembles an Ionic Greek temple. However, a closer look at the side and rear elevations reveals that the columns are engaged with the cella wall and not freestanding. Expanding the cella to the limits of the surrounding colonnade provides a larger interior space and reinforces the axiality of the whole.

Not all Roman temples were rectangular. The Greeks had built circular tholoi, and the Romans applied the circular ground plan to temples. One of the most striking is the Temple of the Sibyl (ca. 25 BCE) in Tivoli. Set on a promontory, it seems to reflect Greek precedent in both its design and siting. It is, however, distinctly Roman. The approach is axial, via a flight of stairs; the cella wall is constructed of concrete instead of marble blocks; and the ornamental frieze of the Corinthian order has Roman swags and ox skulls. Near the Temple of Fortuna Virilis in Rome is the so-called Temple of Vesta (a temple dedicated to Hercules), a circular-plan temple of the first century BCE that is similar to but slightly larger than the Tivoli example. Later modifications have changed the roof and destroyed the original entablature.

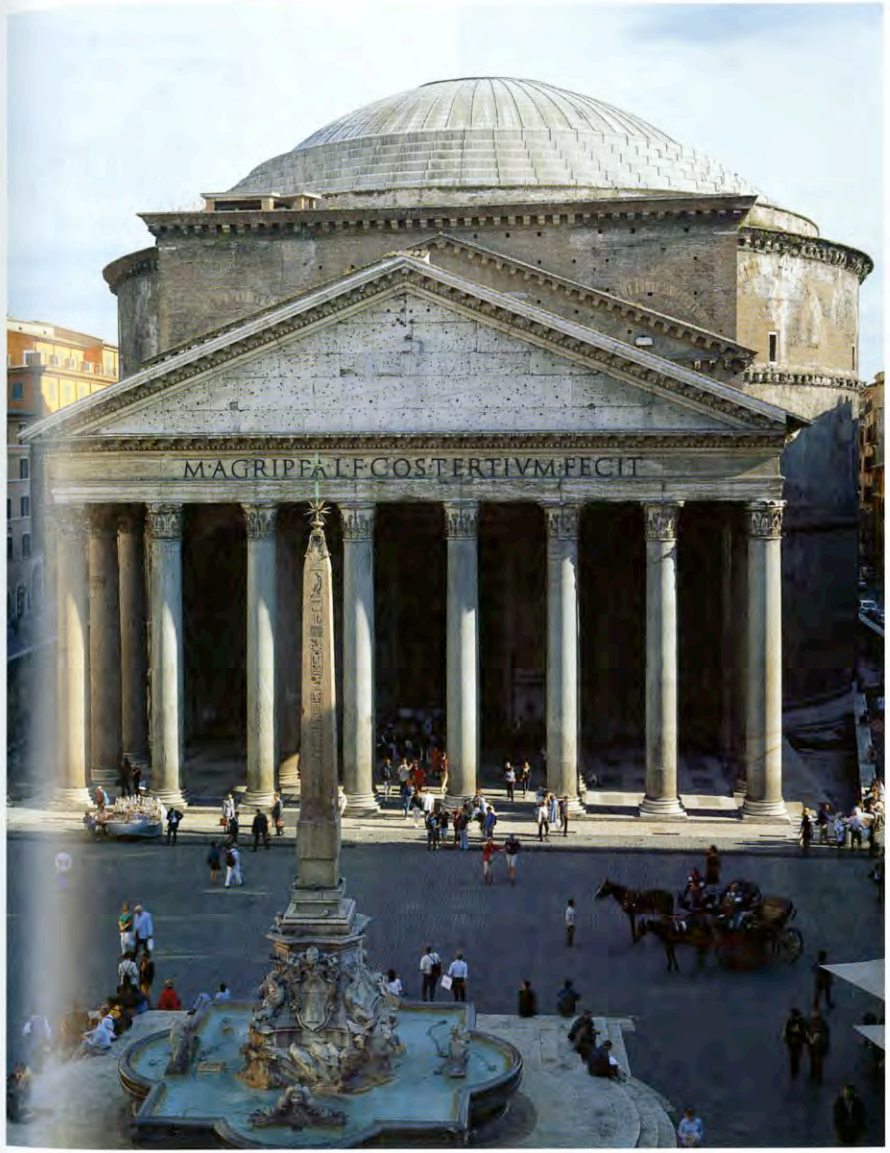
The greatest circular-plan Roman temple is the Pantheon in Rome (ca. 125 CE), considered by many to be the most influential building in Western architectural history (Fig. 5.21). Its size, the boldness of its design, and the technical accomplishment of its construction combine to make it a memorable work. Dedicated to seven planetary deities, the Pantheon was constructed in the reign of the emperor Hadrian, who is reputed to have been its architect. The entrance is an enormous portico with twenty Corinthian columns that originally supported roof trusses (their bronze covering long since removed). This portico is rather awkwardly joined to the circular cella, a space 142 feet and six inches in diameter and 142 feet high. The bottom half of the cella is a cylinder on which rests a hemispherical dome, with a circular opening or **oculus**, twenty-seven feet in diameter, at the top to let in light and air (Fig. 5.22). The contrast of the interior to the exterior is breathtaking, even to modern senses, and it has inspired visitors ever since it was completed. Unlike other pagan temples in Rome, the Pantheon was converted to Christian use and never pillaged for its marble facings, so it remains the Roman building closest to its original state.



5.20 Temple of Fortuna Virilis, Rome, 2nd century BCE.
An early example of a Roman temple, which uses the orders (here, the Ionic) as one might expect from the Greek example, but the building was oriented to an axis in the manner of the Etruscans.

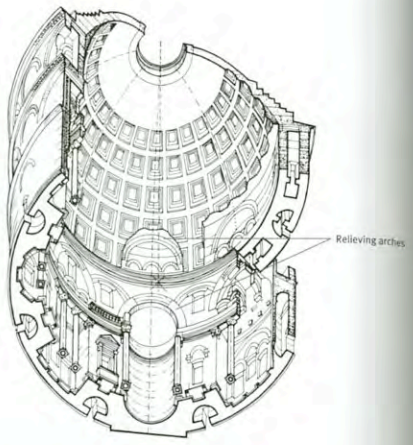
The cylindrical cella wall is visually divided into two stories, a ground-level Corinthian order of fluted columns and pilasters supporting an attic story with rectangular openings resembling windows set in a patterned marble wall. The lower story is varied by niches, alternately semicircular and rectangular, set at quarter and eighth points around the circumference. Articulation in the dome is accomplished by five tiers of diminishing square coffers, designed with exaggerated perspective to enhance the sense of depth. The light pouring in from the oculus emphasizes the three-dimensionality of both the ceiling coffers and the eight niches below. For someone standing in the center of the Pantheon, the building creates the feeling that the space extends beyond the cylindrical drum and that the dome is much higher than its actual dimension.

The conceptual simplicity of the Pantheon's dome-on-drum design should not be mistaken for constructional simplicity (Fig. 5.23). What looks like trabeated construction is in fact a structure based on arches and vaults. Behind the orderly interior columns, veneers, and coffers lies a technical masterpiece, a testament to Roman skill in building with concrete. The immense structural load of the dome is distributed to concrete foundations fifteen feet thick and thirty-four feet wide through drum walls that are up to twenty feet deep. Most of the constructional

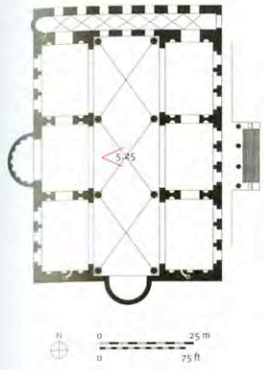


5.21 Pantheon, Rome, ca. 125 CE.
The greatest of Hadrianic architectural projects has become one of the most influential works in Western architectural history, the inspiration for virtually every subsequent domed building. The exterior is imposing, while the interior is overwhelming.

5.22 Giovanni Paolo Panini, *The Interior of the Pantheon*, ca. 1740. Oil on canvas, 4 ft 2 ½ in x 3 ft 3 in (1.28 x .99 m). National Gallery of Art, Washington, DC.
A sphere 142 feet 6 inches in diameter conceptually determines the interior volume of the great dome, which constitutes half of the sphere. Columns in the wall belie the principal structure of arches and vaults that sustain the great dome. Concrete is the primary structural material, faced with marble veneers below and left exposed in the coffering above.



5.23 Axonometric section of the Pantheon, Rome, ca. 125 CE.
This worm's-eye view shows part of the plan and the arched construction behind the internal marble veneers and inside the dome. Although none of this arcuated construction is visible from the interior, relieving arches can be seen on the exterior as in Fig. 5.21.



5.24 (above) Plan of the Basilica Nova (Basilica of Maxentius and Constantine), Rome, 307–15 CE.
This large vaulted building had groin vaults flanked by barrel vaults. Illumination was provided by large clerestory windows.

5.25 (right) Basilica Nova, Rome, 307–15 CE.
Although the groin vaults have collapsed, one set of barrel vaults remains. Astride each bay, the haunches of the groin vaults rise above the parapet. The columns that stood below them were only ornamental.

complexity is not visible on the interior. The first two rings of coffering conceal eight great relieving arches that work with a second set, likewise hidden, to concentrate loads on the wall sections between the niches of the ground story. Even these sections are not solid, but are hollowed by chambers, accessible from the exterior, to equalize contraction of the concrete as it hardened and lessen the dead load transferred to the foundations, all this without compromising the stability of the whole. Aggregate in the concrete mix is progressively lightened, from heavy basalt in the foundations to spongelike volcanic rock (tufa) in the oculus ring.

Virtually every domed building constructed since Roman times makes reference to the Pantheon. Sometimes its influence is very obvious, as in Jefferson's design for the Library at the University of Virginia (see Fig. 13.41), and at other times the connection is less apparent, as in Brunelleschi's dome for Florence Cathedral (see Fig. 11.3). Literally hundreds of domed museums, universities, banks, churches, and railroad stations, to mention only some of the building types, may be found that are ultimately connected to this masterpiece from the time of Hadrian.

PUBLIC BUILDINGS

The Romans developed a number of public building types for specialized functions: the basilica, a large assembly hall used for law courts; the baths, a many-chambered building containing bathing and recreational facilities; and the theater, which was based on the Greek prototype but made into a freestanding structure and sometimes enlarged to become an amphitheater for spectacular entertainments. Each of these building types posed spatial and constructional challenges, and each left its imprint on subsequent architectural developments.

Basilicas

The basilica on the southwest corner of the forum at Pompeii has already been noted. Dated to ca. 100 BCE, it is the oldest known Roman basilica, though it was probably not the first. While it principally housed legal activities, it doubtless also served as a gathering place for social and commercial functions, as did the colonnades of the Greek stoas. In Greek, the word *basilica* literally means "king's hall." Rather than surrounding the exterior as in a stoa, the basilica's colonnades define the longitudinal central space. Entrance to the basilica at Pompeii was made primarily from the short side adjacent to the city governmental offices, but there were lesser entrances on both long sides. Set in a rectangular area in front of the end wall opposite the primary entrance was the tribunal seat of honor, terminating the longitudinal axis established by the colonnades. The building was covered by a wooden gabled roof.

Trajan's Forum in Rome contained the more extensive Basilica Ulpia, which measured 200 by 400 feet excluding the curved end sections (**apses**). Here the entrances were placed in the building's long façades because the basilica completes one side of the forum. On the interior, double colonnades defined the long, narrow central space, and there were triple colonnades across the short sides in front of the semicircular apses. Architectural restoration drawings show the interior with second-floor galleries above the columns on both long sides and clerestory windows illuminating the central space. As at Pompeii, a gabled timber roof covered the building. Luxurious materials, financed by tribute money from Dacia, were employed in the construction: marble on floors and walls, bronze gilding suspended from the roof trusses on the coffered ceiling, and Egyptian granite for the columns. Impressive size, rich finishes, and dramatic lighting combined here to create a setting fit for the dispensation of imperial justice. Of all this magnificence only rude fragments remain, but the basilica form would become the basis for Early Christian church designs.

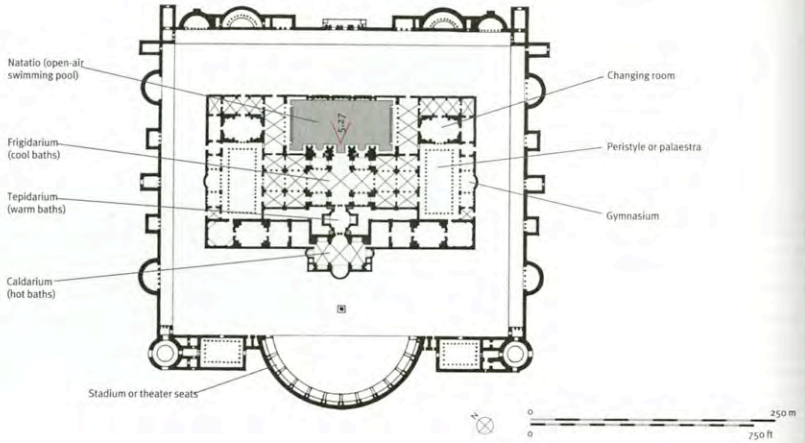
Not all basilicas had files of columns or were timber-roofed. The Basilica Nova (also known as the Basilica of Maxentius and Constantine) in Rome, dated 307–15 CE, had three great groin vaults over its central space, with three barrel-vaulted **bays** to each side (Figs. 5.24–5.25). Structurally, this organization allowed the semicircular barrel vaults and their support walls, all at right angles to the principal axis of the central space, to provide lateral stability for the groin vaults. Finally, the two apses terminated longitudinal and transverse axes.

Public Baths

The interior of the Basilica Nova owed much to the greatest vaulted Roman buildings, the baths. As the name implies, Roman baths (**thermae**) were primarily hygienic facilities, but they also provided for exercise, relaxation, and informal socializing, activities more commonly associated with modern spas or health clubs than with bathrooms. The Romans actually cleaned their bodies without soap by first anointing with oil and then scraping the skin with spoonlike implements. Bathers induced perspiration in hot steam rooms (rather like Finnish saunas) and then cooled down and relaxed in a sequence of temperate and cool plunges. They might extend their time at the baths by swimming, taking walks, enjoying conversation, or reading in the baths' library.

Such an array of activities required an array of spaces: changing rooms, latrines, rooms for hot, warm, and cold bathing; exercise facilities, relaxing areas, and gardens if possible. Adequate water supplies were essential. The Romans used mineral springs when available (the city of Bath in England was one such Roman establishment) and heated the water if the supply was not naturally warm. Because bathing was a healthful diversion for the

5.26 Plan of the Baths of Diocletian, Rome, 298–306 CE.
The large bath building was set within a walled enclosure and provided with landscaped grounds used for exercising, athletic games, or restful walks.



5.27 (opposite) Remains of the Baths of Diocletian, Rome, 298–306 CE.
The central section of the frigidarium has survived and was converted into a church, S. Maria degli Angeli, by Michelangelo. Note the groin vaults and the thermal windows. The finishes remind us how grand these spaces were when intact and well kept.

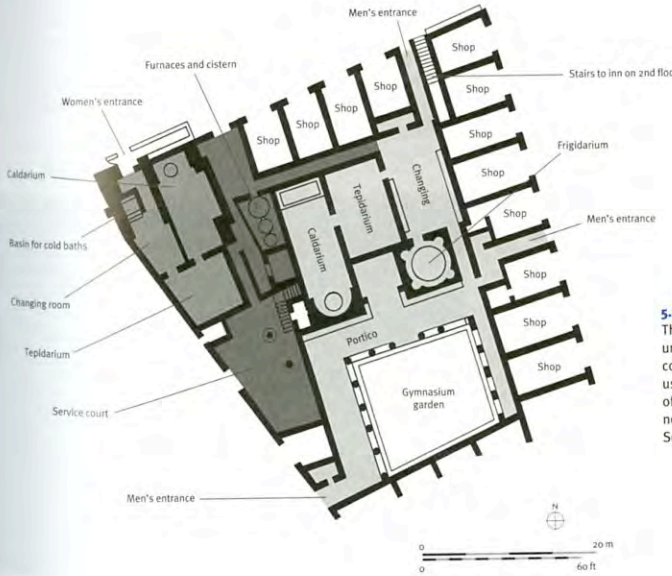
large urban population, the later emperors vied with one another to build ever more elaborate complexes in Rome.

The Baths of Diocletian (298–306 CE) were the largest such complex in ancient Rome, covering about fifty acres of land, and were said to have the capacity for 3000 people (Fig. 5.26). The entire complex was symmetrically designed, with the principal sequence of rooms within the bath building placed on the central axis. From the center of the southwest façade, these included the groin-vaulted hot baths (**caldarium**), domed warm baths (**tepidarium**), cruciform cool baths (**frigidarium**), and open-air swimming pool (natatio). On either side of this central suite of spaces were oval-plan changing rooms and an unroofed rectangular **peristyle** or palaestra for exercising surrounded by ancillary service rooms, the use of which cannot be completely identified. **En suite**, or adjacent, rooms on the south side may have been steam rooms leading up to the caldarium. Interiors were finished with sumptuous materials, marble veneers, and mosaics; statues were placed both inside and out; and the grounds were landscaped with trees and gardens to create a congenial environment for exercise, conversation, and relaxation. A large **exedra** in the southwest exterior wall was fitted with tiered seats for use as a theater or stadium. Rectangular rooms to either side may have contained libraries. Of this vast structure, only parts survive. In 1561, Michelangelo converted the frigidarium into the Church of S. Maria degli Angeli (Fig. 5.27), so that the interior reflects the scale and some of the splendor of the Roman original. One corner rotunda has been transformed into the Church of S. Bernardo, and a trace of the great southern exedra has been preserved in the nineteenth-century Piazza dell'Esedra near the present railroad station.

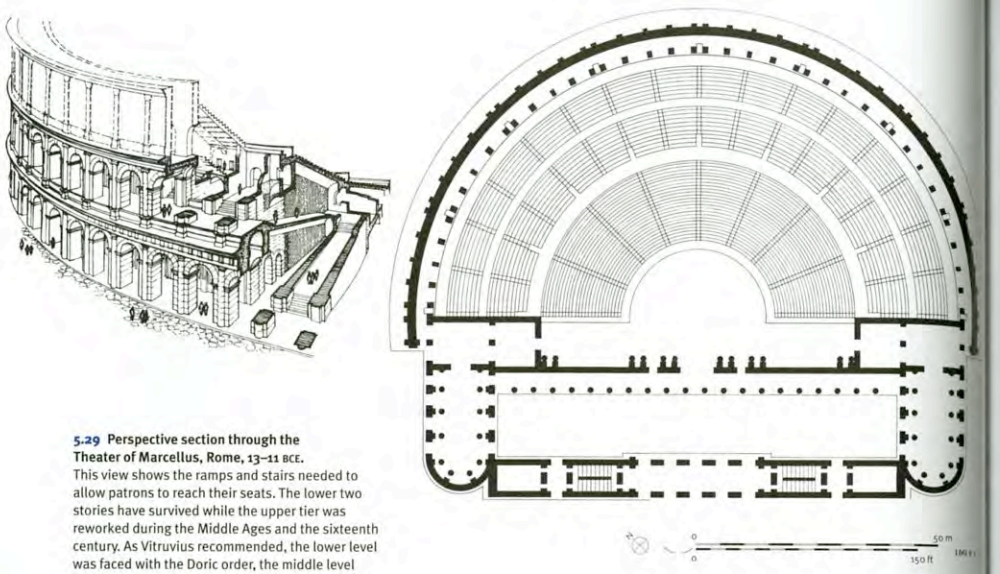
The Baths of Diocletian were exceptionally large, even by the standards of imperial times. Of ancient Rome's over 950 baths listed in a mid-fourth-century inventory, only a handful were this grand. One can appreciate the more common baths' designs by looking at buildings that remain in provincial cities, such as the Forum Baths at Pompeii (Fig. 5.28), Paris (where the Cluny Museum incorporates part of a third-century CE baths), or Leptis Magna on the North African coast, where the so-called Hunting Baths (late second or early third century CE) are exceptionally well preserved.

Theaters and Amphitheaters

Athletic competitions and dramatic performances were part of the culture of ancient Greece. The Romans, who inherited these traditions and added to them the gladiatorial combats of the Etruscans, needed theaters and stadiums in which to stage these events. Greek building practice was to carve the shape of theaters or stadiums out of hillsides, thus adapting the sloping natural setting



5.28 Forum Baths, Pompeii, ca. 80 BCE.
This is a small facility with separate but unequal sections for men and women. A common service area (dark shading) was used for heating water. Shops occupy most of the street frontage, since there was no need for an impressive street presence. See Fig. 5.8 for location within the city.



5.29 Perspective section through the Theater of Marcellus, Rome, 13–11 BCE.
This view shows the ramps and stairs needed to allow patrons to reach their seats. The lower two stories have survived while the upper tier was reworked during the Middle Ages and the sixteenth century. As Vitruvius recommended, the lower level was faced with the Doric order, the middle level with the Ionic order, and the upper level possibly with the Corinthian order.

to tiered seating, but the Romans chose to construct their facilities whether the terrain was favorable or not, so they developed great vaulted structures to create the slope needed for spectator viewing. An early result of this process was the Theater of Marcellus (completed 13–11 BCE) in Rome (Figs. 5.29–5.30), where a great semicircle of 11,000 seats rising in three tiers focused on a rectangular stage building that formed the backdrop for the drama. (This theater had the same capacity as the Greek theater at Epidauros.) Enough of the original construction has survived reuse, first as a medieval fortress and then as a Renaissance palace, to permit reasonable understanding of the structural ingenuity underlying the plan. Stacked radial barrel vaults accommodating ingress and egress, and ramps and stairs made of cut stone and concrete, were intersected by concentric rings of barrel vaults accommodating internal circulation. Fragmentary remains of the exterior veneer frame the arched terminations of the radial barrel vaults in the form of engaged half-columns and entablatures of the Doric and Ionic orders on the ground and second levels, respectively.

The design of theaters doubtless inspired that of amphitheaters ("amphi," meaning "both sides," so a theater on both sides), which were circular or oval in plan, with raked seating all around. The amphitheater at Pompeii, dating from about 80 BCE and the oldest surviving example, was sited so that seats at one end of the oval could be supported on rising ground (Fig. 5.31). Later amphitheaters built in southern France at Arles and Nîmes were constructed almost entirely above ground level.

5.30 Plan of the Theater of Marcellus, Rome, 13–11 BCE.
Roman theaters were based on designs already perfected by the Greeks. The difference here is that support for the seats depends not on a convenient hillside but rather on a vaulted structure of cut stone and concrete.

5.31 The amphitheater, Pompeii, ca. 80 BCE.
This oval-shaped arena was used for the gladiatorial contests of which the Romans were exceedingly fond. Part of its seating is supported on arched construction and part is built into rising ground.

Greatest of all was the Flavian Amphitheater in Rome, more commonly known as the Colosseum, completed in 80 CE (Fig. 5.32). Although the building's plan is the familiar oval and its structure is modeled on that of the Theater of Marcellus, the novel element here is size. The outside dimension of the oval measures 510 by 615 feet, encompassing seats for an estimated 50,000 people in a continuously rising tier with an additional seating band above. Except for this top level of seats, which rested on wooden supports, the entire building was masonry, a combination of cut stone and concrete resting on carefully laid foundations. Under the seating was an intricate network of structural supports, horizontal passageways, ramps, and stairs to accommodate the attending throngs. The exterior walls were clad in travertine, usually a cream-colored marble. Stacked half-columns in the Roman Doric, Ionic, and Corinthian orders combined with arches of the supporting barrel vaults to create three stories of the façade. A fourth level of Corinthian pilasters without arches completed the elevation around two upper galleries (reserved for women and slaves). Attached to this level were brackets for the poles that some historians believe to have been supports for a canvas cover (velarium) providing shade for spectators. The area under the arena floor, an oval measuring 175 by 280 feet, was a labyrinth of passageways and chambers for gladiators, beasts, and hoisting machinery to service the spectacles staged above. The Colosseum is inextricably linked with savage and cruel entertainment, including fights to the death by gladiators and the persecution of Roman Christians. During later eras the fine marble work was removed as the building became a source for ready-cut stone. It remains today as a partial ruin, but even in its crumbled condition the Colosseum testifies to Roman construction skill.

5.32 The Colosseum (Flavian Amphitheater), Rome, completed 80 CE.
Grandest of all the Roman arenas, the Colosseum was once entirely clad in travertine, some of which remains in the form of applied orders, as seen here on the left side of the image. From bottom to top, these are Doric, Ionic, and Corinthian attached columns and a crowning level of Corinthian pilasters. On the right side of the arena these have been lost, exposing the structural piers and arches. Tiers of seating on the inside worked their way down to the chambers beneath the former floor.

RESIDENCES

To study Roman housing, we once again return to Pompeii, for the collection of ordinary dwellings, elaborate town residences, country villas, and farmhouses preserved there provides the most complete record we have of the types of buildings in which people lived. The earliest houses have atrium plans, an indigenous Italian type in which the principal rooms of the house directly adjoin an open courtyard for access and for light and circulation of air. Such a house presents a blank wall to the street on which it fronts without setback from the sidewalk.

Urban Housing

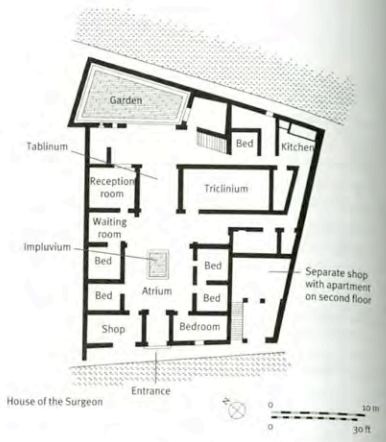
The House of the Surgeon is the most ancient dwelling found in Pompeii, and an examination of its plan reveals the typical features of atrium houses (Fig. 5.33). It is an irregular quadrilateral because it exactly fills the plot of land on which it was built. On the street side it has three doors, two of which provide access to shops, one connected to the dwelling and the other forming part of a self-contained environment with living quarters upstairs. The center doorway, dignified by two entrance steps, was the principal entry to the house, and its location defines the axis of symmetry for the house proper. Passing through a vestibule, a visitor would next encounter the atrium, where a roof provided covering and shade except for a relatively small central area that was left open to the sky. Water running off the roof would fall in a basin (**impluvium**) in the center of the atrium. On either side of the atrium were chambers generally used as bedrooms; straight ahead on axis was the main reception room (**tablinum**), flanked by a dining room (**triclinium**). Beyond was a portico that opened onto the rear walled garden. Service spaces, including chambers for servants and the kitchen, were set in the wing beside the dining room. All the internal spaces depended on the unroofed atrium or the garden for light,

as the exterior walls were without openings. Only the tablinum, the most distinguished room in the house, had direct access to both sources (and thus to the cooling breezes that would pass through); most of the remaining rooms must have been rather dim, even during the day.

The atrium plan had formal dignity and practicality too. The owner could rent the frontage shop with second-floor living quarters to a tradesman or artisan and use the shop connected to the interior of the house as his own place of business. The functioning of either shop was independent of domestic activity, which was in turn isolated from street noise. The scale was ample. The private quarters in the House of the Surgeon covered about 5500 square feet, including the garden. Nevertheless, in the second century BCE wealthier citizens were constructing expanded atrium houses. These newer houses might have more than one atrium, and the garden was greatly enlarged and surrounded by a colonnade to become a peristyle (Figs. 5.35–5.36).

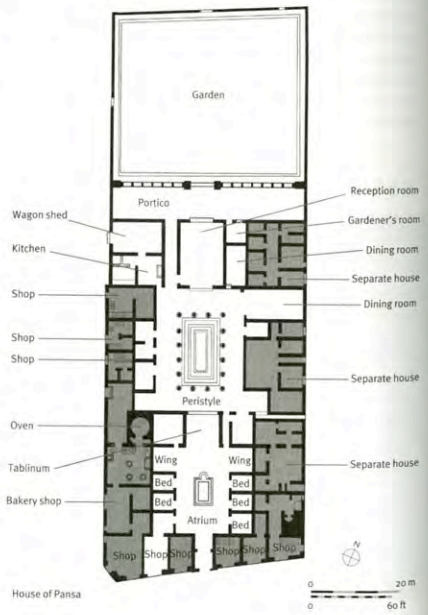
The House of Pansa at Pompeii is an example of the atrium-peristyle house that has been dated to the mid-second century BCE (Fig. 5.34). It occupies virtually one entire city block (approximately 27,000 square feet, over half an acre) and thus might have had windows on any of its four sides, but it has none, relying instead on an atrium, peristyle court, and a large walled garden for light and air. The entrance establishes an axial disposition of spaces similar to that at the House of the Surgeon. The small rooms around the atrium were used as bedrooms, with the dining rooms set adjacent to the peristyle. Beyond the peristyle, the axis passes through another reception room and portico to the walled garden, which occupied about a third of the site. Such a large house was uncommon in Pompeii. Examples of three smaller houses can be seen along the side street of the House of Pansa, where they were created out of the main house in a later remodeling. Lacking an atrium or internal court, these houses had windows for light and air, but they opened to the street, thus sharing the dust, noise, and smells of the public way. The two remaining sides of the House of Pansa contained shops. One can see the masonry mass surrounding the oven of a bakery on the plan.

Inward-looking houses such as those at Pompeii present a virtual wall to the street, an effect completely unlike the residential districts of American cities but not so dissimilar to the modern towns in Mediterranean countries. The streets in Pompeii were usually narrow, ranging from under eight to just over twenty-two feet. Major streets had raised walks on either side, and raised stepping stones at intersections enabled pedestrians to cross the street without sinking into the muck that often filled the roadway (Fig. 5.37). These crossing stones also permitted wheeled carts to pass, carefully, and thus controlled traffic speed. The walls in most sections of town were covered with graffiti. Election slogans, public notices, advertisements for commercial establishments and public entertainments,



5-33 Plan of the House of the Surgeon, Pompeii, 2nd century BCE.
This plan is organized around a central open space or atrium that admitted fresh air and light to surrounding rooms. A portico or porch at the rear opened into a small garden. Positioned between these two elements was the tablinum or main reception room.

5-34 Plan of the House of Pansa, Pompeii, 2nd century BCE.
This house is so extensive that it occupies virtually an entire block and includes a spacious walled garden at the rear. Fresco paintings decorated its walls and mosaic tiles many of its floors.



5-35 Atrium of the House of Venus in the Shell, Pompeii, 2nd century BCE.
The roof has been restored to give an idea of the original space and light quality. Water running off the roof collected in the impluvium at the center of the atrium. Fresco painting can be seen at the left. The opening in the center led to the garden peristyle. Notice the opus incertum stonework facing of the walls.

5-36 Peristyle of the House of Venus in the Shell, Pompeii, 2nd century BCE.
The house takes its name from a fresco found on the peristyle wall (to the left, not visible in the photograph). Fragments of other wall frescoes are evident to the rear. The dining room opened on the garden.

and obscene remarks have all been found in the excavations of the city. On streets where tradesmen had shops, the walls sometimes contained murals illustrating the particular trade or product available within. Shop fronts opened directly to the street for the display of goods and were secured at night by wooden roller shutters.

Interior finishes in the houses at Pompeii have proven almost as interesting as the architecture. Art historians have identified four styles of wall paintings at Pompeii. One of these, in which imaginary scenes were painted as viewed from high or low vantage points, anticipates the elaborate Baroque creations that were used in the seventeenth

5-37 Street in Pompeii, 2nd century BCE.
Shop fronts predominated along the street, with the entrances to houses being rather modest openings. Carts could pass between the raised stepping stones and sidewalks. Notice the opus testaceum stonework facing of the walls here and in Fig. 5.38.

5.38 Insula (tenement building), Ostia, 2nd century CE.
Much of the urban population in Rome lived in accommodation similar to this building. Cooking facilities for all units were located on the roof to minimize odors and the danger of fire, and water had to be carried from the public supply.

century to expand optically the physical boundaries of walls and ceilings.

Stone and brick were the primary materials used in the construction of houses, although a surprising amount of timber was also employed, particularly for roof beams. In less affluent situations, walls were often provided by a wooden structural frame filled with rubble or brick, rather like the **half-timbering** construction of medieval Europe. Dwellings were originally one story, but as a city grew and urban land became more valuable, construction inevitably became multi-story, and older houses were converted to apartments. By the time of Pompeii's destruction, in fact, many of the atrium-peristyle houses had been divided into multi-family dwellings, as the wealthier citizens had moved to more spacious residences on estates outside the city.

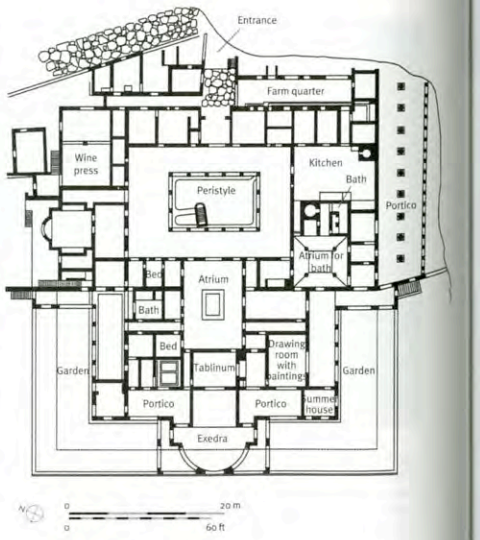
For city residents, the dominant housing type after the fire that destroyed much of Rome in 64 CE came to be the apartment block or **insula**. An inventory made in the fourth century of buildings in Rome counted 46,000 insulae, while there were fewer than 1800 single-family houses. The best surviving insulae are found in the port city of Ostia (Fig. 5.38). These apartment buildings, ranging up to six floors in height, occupied substantial plots of land and were designed around central courtyards. Shops or commercial ventures were located on the ground-floor street frontages. Unlike the atrium houses, however, the upper-floor walls of insulae had windows opening to the street, so that rooms could draw on both the courtyard and street for light and air.

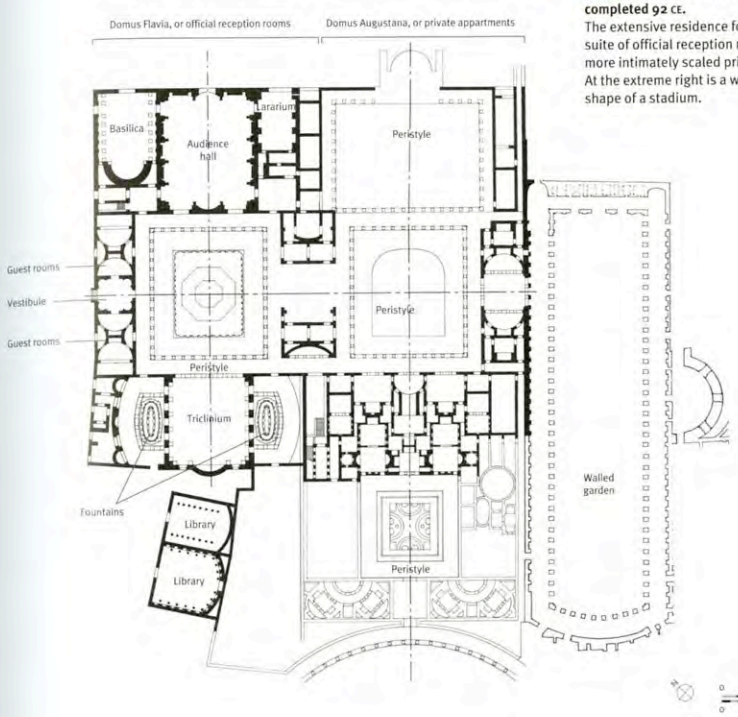
Rural Villas and Urban Palaces

Residences outside cities were called **villas**, and at Pompeii, a fine example is preserved just beyond the city wall. Known as the Villa of the Mysteries (Fig. 5.39) because of the wall paintings in one room that relate to the mystical cult of Bacchus, it grew gradually over a period of 300 years from a simple house to a complex of sixty rooms. Elements from atrium houses remain in its plan, including the preference for axial symmetry, but the ordering of rooms differs. The entrance led into the peristyle, followed by the atrium and finally the tablinum, while extensive terraced gardens surrounded the villa on the three non-entrance sides. Based upon the original inward-focused house, the architectural developments at the Villa of the Mysteries seem to suggest a building in which the exterior elevations and their connection with the surrounding countryside were becoming more important.

The ruins of the Palace of Domitian, built to the design of the architect Rabirius for the emperor Domitian (finished in 92 CE) on the Palatine Hill (Fig. 5.40), suggest the complexity of elements incorporated into an imperial residence. The northwestern section contained a suite of official

5.39 Plan of the Villa of the Mysteries, Pompeii, ca. 120–80 BCE.
This plan resulted from some 300 years of development and enlargement. The germ of the plan is still the atrium/peristyle combination seen in urban residences, but the house also opens out to the landscape through numerous porticoes.





5.40 Plan of the Palace of Domitian, Rome, completed 92 CE.
The extensive residence for the emperor has a suite of official reception rooms (left) and a set of more intimately scaled private apartments (right). At the extreme right is a walled garden in the shape of a stadium.

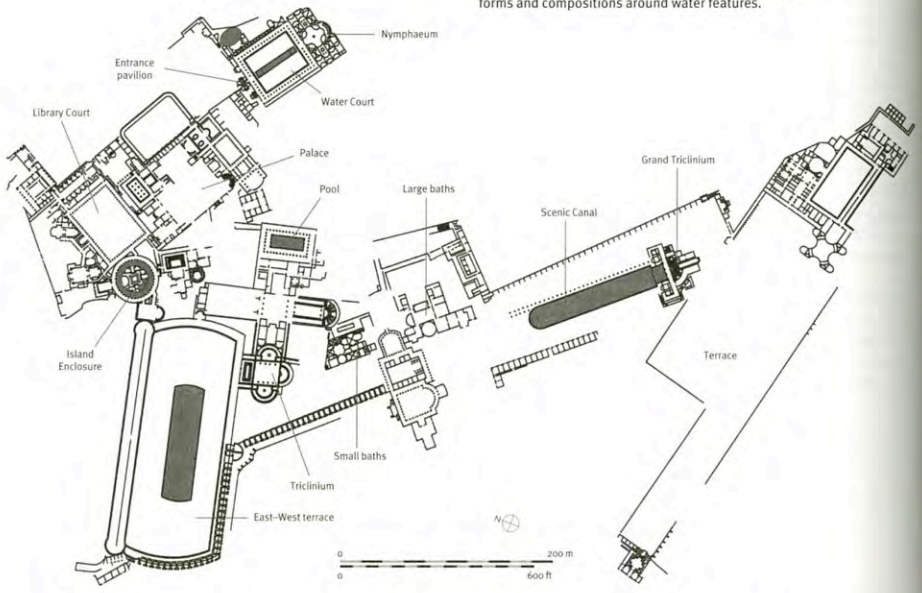
rooms, arranged along cross-axes, with a grand audience hall, peristyle with fountain, and a large vaulted triclinium with an exedra at the end to mark the emperor's seat. The more private residence section to the southeast was also organized cross-axially, and its more intimately scaled rooms on two levels present a virtuoso display of architectural ingenuity, incorporating varied room shapes, colonnaded gardens with fountains, and ornamental sculpture.

Interest in exploring such complex arrangements continued at the imperial villa erected by the emperor Hadrian outside Tivoli (Figs. 5.41–5.42). Constructed between 117 and 138 CE, it is a vast, sprawling accumulation of geometrically controlled building groups sited to follow the topography and linked to one another by a shifting set of axes and cross-axes. Passionate about architecture and widely traveled, Hadrian may have intended his villa to evoke architectural forms from all parts of the world, but there are no Disneyland-like copies of foreign buildings. Rather, it is the sheer variety of interior volumes and exterior vistas, as if the designers were experimenting with imaginative and untried forms, that make this a treasury of sequential spatial experiences without precedent.

The most recent scholarship on the villa has stripped away sometimes fanciful names traditionally associated with features found here in preference for descriptive terms, as the old names (given here in parentheses) were assigned by romantically inclined amateurs and not Hadrian himself. An enclosed garden around a rectangular fish pond forms the East–West Terrace (the Poikele), the largest single element in the villa. Below the western end of the terrace are tiers of rooms where as many as 700 villa staff and servants were housed out of sight but close at hand.

To the east was the Island Enclosure (Maritime Theater), a circular, enclosed colonnaded area surrounded by a moat that provided a retreat for meditation or intimate meetings. Water is also the central feature of the Scenic Canal (Canopus), a long colonnaded pool that was lined with statuary and focused at its southern end on a

5.41 Plan of Hadrian's Villa, Tivoli, 117–38 CE.
It is hard to convey in a single drawing the complexity of this sprawling collection of buildings, which covers twice as much area as the city of Pompeii. Hadrian's architects exploited the structural possibilities of concrete to build unprecedented forms and compositions around water features.



grand triclinium (the Serapeum), or banqueting hall, that became a grotto.

To the north of the Island Enclosure was the residential area, which included parts of an earlier family villa on the site, grouped around a rectangular court. Of greater interest from the standpoint of design sophistication is the Water Court (Piazza d'Oro or Golden Court), built on the northeast edge of the villa. The central axis of the composition was defined by an octagonal domed entrance pavilion that sat opposite the celebrated reverse-curve **Nymphaeum** or water pavilion.

CONCLUSIONS ABOUT ARCHITECTURAL IDEAS

The Romans were the first ancient people to build large interior spaces. They did so by mastering the art of masonry vaulting, using brick and stone throughout the Empire and concrete within the Italian peninsula, where the raw ingredient pozzolana was available. In the end, it is impossible to understand the arrangement of spaces at such sites as the Palace of Domitian or Hadrian's Villa without understanding the structural principles at work. In fact, from ancient Roman times to the second half of the twentieth century, it will be the supporting of the ceiling, most commonly with masonry vaulting, on which architects will lavish the most time and expense.

While the work of the Republic was largely trabeated and benefited from the planning experiments carried out by the Hellenistic Greeks, the architectural work of the Empire utilized elements of the classical language, particularly the orders, primarily as an exterior and interior veneer or as screens, giving elegance and proportion to the huge piles of compressive masonry that did most of the real work of spatial enclosure. The Colosseum, with its intersecting stacks of radial and concentric barrel vaults that provide access tunnels and support the seating and with its superimposed Doric-Ionic-Corinthian orders around the outer perimeter wall, provides a famous example, as does the Pantheon, with its system of relieving arches and its coffered dome, still the standard by which domed spaces are measured.

A complex such as the Forum of Trajan illustrates the continuity of Hellenistic planning for official or corporate

5.42 Aerial view, Hadrian's Villa, Tivoli, 117–38 CE.
The orientation of this photograph is an inversion of the site plan seen in Fig. 5.41, so that north is more or less to the right. The basin of the East–West Terrace can be seen at the upper right, with the circular Island Enclosure below it. The baths and Scenic Canal extend to the left. Part of the irregularity of the layout can be attributed to the designers accommodating various terrain features.

spaces and the introduction of vaults for utilitarian ones. Within the forum, stoalike files of columns are folded and bent to capture exterior spaces that become the precincts for a temple, a triumphal column, and an equestrian statue, and the intervening basilica is also completely trabeated. The Markets of Trajan that hold back the earth to the northeast employ barrel vaults throughout and groin vaults with flying buttresses in the great hall, while the classical language is largely absent. Much the same can be said of the public baths and the Basilica of Constantine, where their ruined state allows us to appreciate their arcuated and domed construction, without the veneer of frescoes, mosaics, and applied orders that have largely fallen away.

Like the builders of Egypt, Mesopotamia, and Greece, the Romans built houses around interior courts, either the paved atrium or gardenlike peristyle. However, their most distinctive housing type was the tenement or insula, with its lower-story shops facing the street. While Rome itself grew over time in an often haphazard way, it was not considered the ideal. When given the opportunity to plan new towns, the Romans employed grid layouts into which they inserted public spaces, temples, baths, theaters, and amphitheaters, as at Timgad (see Fig. 5.11).

In Western Europe, all of this Roman architecture would lie fallow for centuries after the fall of the Empire, only to be reborn in the fifteenth century as a result of investigations and experiments, first made by Italians, then by others through Europe and England, as will be discussed in Chapter 11.