



Station #7 – Renaissance Architecture

The Duke of Milan Francesco I Sforza ordered construction of a Dominican convent and a church at the site of a prior chapel dedicated to the Marian devotion of St Mary of the Graces. The main architect, Guiniforte Solari, designed the convent, which was completed by 1469. Construction of the church took decades. Duke Ludovico Sforza decided to have the church serve as the Sforza family burial site, and rebuilt the cloister and the apse, both completed after 1490. Ludovico's wife Beatrice was buried in the church in 1497.

Results of the Allied raid in 1943.

The design of the apse of the church has been attributed to Donato Bramante, who at the time was in the service of the Duchy; however, there is scant documentary evidence linking Bramante to this church. His name is inscribed in a piece of marble in the church vaults delivered in 1494. Some documents though mention the name Amadeo, likely Giovanni Antonio Amadeo. Similarities between this church and Amadeo's design for Santa Maria alla Fontana make this attribution more likely.

Antonio da Sangallo the Younger, (1485–1546), was one of a family of military engineers. His uncle, Giuliano da Sangallo was one of those who submitted a plan for the rebuilding of St Peter's and was briefly a co-director of the project, with Raphael.

Antonio da Sangallo also submitted a plan for St Peter's and became the chief architect after the death of Raphael, to be succeeded himself by Michelangelo.

His fame does not rest upon his association with St Peter's but in his building of the Farnese Palace, "the grandest palace of this period", started in 1530. The impression of grandness lies in part in its sheer size, (56 m long by 29.5 meters high) and in its lofty location overlooking a broad piazza. It is also a building of beautiful proportion, unusual for such a large and luxurious house of the date in having been built principally of stuccoed brick, rather than of stone. Against the smooth pink-washed walls the stone quoins of the corners, the massive rusticated portal and the stately repetition of finely detailed windows give a powerful effect, setting a new standard of elegance in palace-building. The upper of the three equally sized floors was added by Michelangelo. It is probably just as well that this impressive building is of brick; the travertine for its architectural details came not from a quarry, but from the Colosseum.



Michelangelo Buonarroti (1475–1564) was one of the creative giants whose achievements mark the High Renaissance. He excelled in each of the fields of painting, sculpture and architecture and his achievements brought about significant changes in each area. His architectural fame lies chiefly in two buildings: the interiors of the Laurentian Library and its lobby at the monastery of San Lorenzo in Florence, and St Peter's Basilica in Rome.

St Peter's was "*the greatest creation of the Renaissance*",^[2] and a great number of architects contributed their skills to it. But at its completion, there was more of Michelangelo's design than of any other architect, before or after him.



Saint Peter's

The plan that was accepted at the laying of the foundation stone in 1506 was that by Bramante. Various changes in plan occurred in the series of architects that succeeded him, but Michelangelo, when he took over the project in 1546, reverted to Bramante's Greek-cross plan and redesigned the piers, the walls and the dome, giving the lower weight-bearing members massive proportions and eliminating the encircling aisles from the chancel and identical transept arms. Helen Gardner says: "Michelangelo, with a few strokes of the pen, converted its snowflake complexity into a massive, cohesive unity."

Michelangelo's dome was a masterpiece of design using two masonry shells, one within the other and crowned by a massive lantern supported, as at Florence, on ribs. For the exterior of the building he designed a giant order which defines every external bay, the whole lot being held together by a wide cornice which runs unbroken like a rippling ribbon around the entire building.

There is a wooden model of the dome, showing its outer shell as hemispherical. When Michelangelo died in 1564, the building had reached the height of the drum. The architect who succeeded Michelangelo was Giacomo della Porta. The dome, as built, has a much steeper projection than the dome of the model. It is generally presumed that it was della Porta who made this change to the design, to lessen the outward thrust. But, in fact it is unknown who it was that made this change, and it is equally possible and a stylistic likelihood that the person who decided upon the more dynamic outline was Michelangelo himself at some time during the years that he supervised the project.



The vestibule of the Laurentian Library

Laurentian Library

Michelangelo was at his most Mannerist in the design of the vestibule of the Laurentian Library, also built by him to house the Medici collection of books at the convent of San Lorenzo in Florence, the same San Lorenzo's at which Brunelleschi had recast church architecture into a Classical mold and established clear formula for the use of Classical orders and their various components.

Michelangelo takes all Brunelleschi's components and bends them to his will. The Library is upstairs. It is a long low building with an ornate wooden ceiling, a matching floor and crowded with corbels finished by his successors to Michelangelo's design. But it is a light room, the natural lighting streaming through a long row of windows that appear positively crammed between the order of pilasters that march along the wall. The vestibule, on the other hand, is tall, taller than it is wide and is crowded by a large staircase that pours out of the library in what Pevsner refers to as a "flow of lava", and bursts in three directions when it meets the balustrade of the landing. It is an intimidating staircase, made all the more so because the rise of the stairs at the center is steeper than at the two sides, fitting only eight steps into the space of nine.

The space is crowded and it is to be expected that the wall spaces would be divided by pilasters of low projection. But Michelangelo has chosen to use paired columns, which, instead of standing out boldly from the wall, he has sunk deep into recesses within the wall itself. In San Lorenzo's church nearby, Brunelleschi used little scrolling console brackets to break the strongly horizontal line of the course above the arcade. Michelangelo has borrowed Brunelleschi's motifs and stood each pair of sunken columns on a pair of twin console brackets. Pevsner says the "Laurenziana... reveals Mannerism in its most sublime architectural form"



French Renaissance: Château de Chambord (1519–39)

During the early years of the 16th century the French were involved in wars in northern Italy, bringing back to France not just the Renaissance art treasures as their war booty, but also stylistic ideas. In the Loire Valley a wave of building was carried and many Renaissance châteaux appeared at this time, the earliest example being the Château d'Amboise (c. 1495) in which Leonardo da Vinci spent his last years. The style became dominant under Francis I (See Châteaux of the Loire Valley).

By the beginning of the 15th century, after a hundred years of construction, the structure was still missing its [dome](#). The basic features of the dome had been designed by Arnolfo di Cambio in 1296. His brick model, 4.6 metres (15.1 ft) high, 9.2 metres (30.2 feet) long, was standing in a side aisle of the unfinished building, and had long been sacrosanct. It called for an octagonal dome higher and wider than any that had ever been built, with no external buttresses to keep it from spreading and falling under its own weight.



The commitment to reject traditional Gothic buttresses had been made when Neri di Fioravanti's model was chosen over a competing one by Giovanni di Lapo Ghini. That architectural choice, in 1367, was one of the first events of the Italian Renaissance, marking a break with the Medieval Gothic style and a return to the classic Mediterranean dome. Italian architects regarded Gothic flying buttresses as ugly makeshifts. Furthermore, the use of buttresses was forbidden in Florence, as the style was favored by central Italy's traditional enemies to the north. Neri's model depicted a massive inner dome, open at the top to admit light, like Rome's Pantheon, but enclosed in a thinner outer shell, partly supported by the inner dome, to keep out the weather. It was to stand on an unbuttressed octagonal drum. Neri's dome would need an internal defense against spreading (hoop stress), but none had yet been designed.

The building of such a masonry dome posed many technical problems. Brunelleschi looked to the great dome of the Pantheon in Rome for solutions. The dome of the Pantheon is a single shell of concrete, the formula for which had long since been forgotten. Soil filled with silver coins had held the Pantheon dome aloft while its concrete set. This could not be the solution in the case of a dome this size and would put the church out of use. For the height and breadth of the dome designed by Neri, starting 52 metres (171 ft) above the floor and spanning 44 metres (144 ft), there was not enough timber in Tuscany to build the scaffolding and forms. Brunelleschi chose to follow such design and employed a double shell, made of sandstone and marble. Brunelleschi would have to build the dome out of brick, due to its light weight compared to stone and being easier to form, and with nothing under it during construction. To illustrate his proposed structural plan, he constructed a wooden and brick model with the help of Donatello and Nanni di Banco, a model which is still displayed in the Museo dell'Opera del Duomo. The model served as a guide for the craftsmen, but was intentionally incomplete, so as to ensure Brunelleschi's control over the construction.



Brunelleschi's solutions were ingenious, such as his use of the catenary arch for support. The spreading problem was solved by a set of four internal horizontal stone and iron chains, serving as barrel hoops, embedded within the inner dome: one at the top, one at the bottom, with the remaining two evenly spaced between them. A fifth chain, made of wood, was placed between the first and second of the stone chains. Since the dome was octagonal rather than round, a simple chain, squeezing the dome like a barrel hoop, would have put all its pressure on the eight corners of the dome. The chains needed to be rigid octagons, stiff enough to hold their shape, so as not to deform the dome as they held it together.



Each of Brunelleschi's stone chains was built like an octagonal railroad track with parallel rails and cross ties, all made of sandstone beams 43 centimetres (17 in) in diameter and no more than 2.3 metres (7.5 ft) long. The rails were connected end-to-end with lead-glazed iron splices. The cross ties and rails were notched together and then covered with the bricks and mortar of the inner dome. The cross ties of the bottom chain can be seen protruding from the drum at the base of the dome. The others are hidden. Each stone chain was supposed to be reinforced with a standard iron chain made of interlocking links, but a magnetic survey conducted in the 1970s failed to detect any evidence of iron chains, which if they exist are deeply embedded in the thick masonry walls. Brunelleschi

also included vertical "ribs" set on the corners of the octagon, curving towards the center point. The Ribs, 13 feet (4 meters) deep, are supported by 16 concealed ribs radiating from center. The ribs had slits to take beams that supported platforms, thus allowing the work to progress upward without the need for scaffolding.

A circular masonry dome can be built without supports, called centering, because each course of bricks is a horizontal arch that resists compression. In Florence, the octagonal inner dome was thick enough for an imaginary circle to be embedded in it at each level, a feature that would hold the dome up eventually, but could

not hold the bricks in place while the mortar was still wet. Brunelleschi used a herringbone brick pattern to transfer the weight of the freshly laid bricks to the nearest vertical ribs of the non-circular dome.

The outer dome was not thick enough to contain embedded horizontal circles, being only 60 centimetres (2 ft) thick at the base and 30 centimetres (1 ft) thick at the top. To create such circles, Brunelleschi thickened the outer dome at the inside of its corners at nine different elevations, creating nine masonry rings, which can be observed today from the space between the two domes. To counteract hoop stress, the outer dome relies entirely on its attachment to the inner dome and has no embedded chains.

A modern understanding of physical laws and the mathematical tools for calculating stresses were centuries in the future. Brunelleschi, like all cathedral builders, had to rely on intuition and whatever he could learn from the large scale models he built. To lift 37,000 tons of material, including over 4 million bricks, he invented hoisting machines and lewissons for hoisting large stones. These specially designed machines and his structural innovations were Brunelleschi's chief contribution to architecture. Although he was executing an aesthetic plan made half a century earlier, it is his name, rather than Neri's, that is commonly associated with the dome.

Brunelleschi's ability to crown the dome with a lantern was questioned and he had to undergo another competition, even though there had been evidence that Brunelleschi had been working on a design for a lantern for the upper part of the dome. The evidence is shown in the curvature, which was made steeper than the original model. He was declared the winner over his competitors Lorenzo Ghiberti and Antonio Ciaccheri. His design (now on display in the Museum Opera del Duomo) was for an octagonal lantern with eight radiating buttresses and eight high arched windows. Construction of the lantern was begun a few months before his death in 1446. Then, for 15 years, little progress was possible, due to alterations by several architects. The lantern was finally completed by Brunelleschi's friend Michelozzo in 1461. The conical roof was crowned with a gilt copper ball and cross, containing holy relics, by Verrocchio in 1469. This brings the total height of the dome and lantern to 114.5 meters (375 ft). This copper ball was struck by lightning on 17 July 1600 and fell down. It was replaced by an even larger one two years later.