

Pietro da Cortona's domes between new experimentations and construction knowledge

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During his lifelong activity Cortona has been dealing, in several circumstances and in many projects, with the problem of the construction of domes. We will examine only the really built structures, making a distinction between remodelling old domes, designed by others, and new works (Cerutti Fusco, Villanni 2002).

Among the Cortona's domes, first we will mention the intervention in S. Maria in Vallicella (1647–1651) and S. Maria della Pace (1656–1659); then, the church of Ss. Luca e Martina (begun in 1634, but continued in a long process of construction), concluding with Cortona's masterpiece of the end of his career, the remarkable dome of the already half built Ss. Ambrogio e Carlo al Corso (1668).

The whole matter, related with the domes' construction in its cultural context, can be investigated either from the side of theory, or from the side of practice.

THE THEORY

As far as the seicento theory on mechanics and static stability is concerned, it is possible to say that the criteria of domes project were dominated by traditional principles of design. Geometry and proportion, plus some basic recommendations on correct and useful construction procedure were later on pointed out as well by sound architects, such as Carlo Fontana, Guarino Guarini and Bernardo

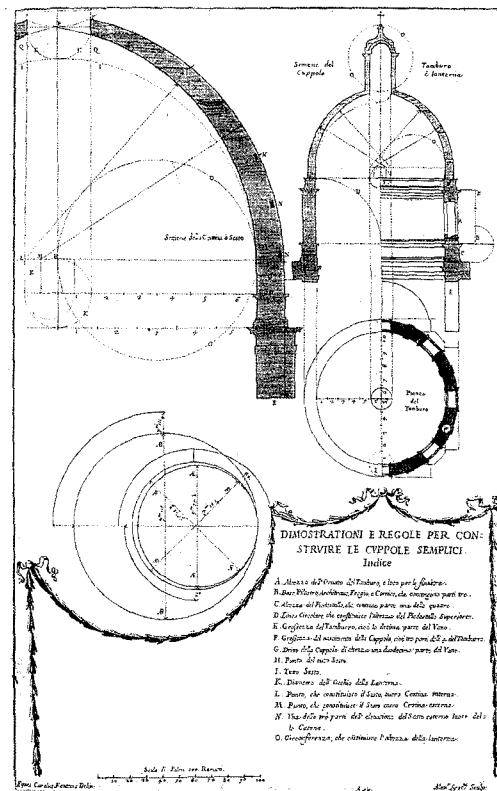


Figure 1
Carlo Fontana's rules for dome's designing (from *Regole per le Cupole Semplici*)

Antonio Vittone. From this point of view, the most important texts in baroque Rome can be considered Fontana's *Dichiaratione dell'operato nella cupola di Monte Fiascone colla difesa della censura* (1673) and *Regole per le Cupole Semplici*, included in his famous *Templum Vaticanum* (1694). According to Fontana, the design of the various elements of the domes descends first of all from simple geometrical principles, and great importance is attributed to the comparison among the most celebrated roman domes. Only a few notes are reserved to the different properties of the building materials.

However, previously, we must here mention Teofilo Gallaccini's treatise *Sopra gli errori degli architetti* (about 1625), at that time still manuscript, but known in the Barberini circle, in which Cortona was well introduced. Physician and lecturer in mathematics in Siena, Teofilo was willing to spread a culture on erecting a sound perennial structure, a culture he acquired studying the roman ruins and the fortification, an interest that he shared with Galileo, whom he was acquainted with. *Sopra gli errori* . . . concerned the construction knowledge, a complex set of rules for building correctly, according with mechanics, including hydraulic, the analysis of soil and foundations, the building procedures, the properties of materials, the technique of masonry. Addressing himself more to the «ministers» or to the patrons than to the architects, whom he was inclined to distrust, he covered a lack of writings, proposing a simple scientific method to design and to control the proportion of the structures, to preview and to diagnose local failures and possible errors or abuses. Indeed his treatise, presenting architecture more as a science than as an art, was at that time the most advanced bridge between practice and theory.

For many reasons, also related to his famous controversy with the Inquisition, Galilei's influence was wide and perceived also by patrons and architects: for example, an important Galileo's contribution to the current knowledge about the equilibrium of the vaults was not only the rigorously mathematical method applied to the problem, but also the bringing in the concepts of friction and boundary conditions (Benvenuto 1981, 102 ff.; Di Pasquale 1995–1997). However, this new approach was particularly useful when the diameter of the circle/oval, or the width of the polygon (usually an octagon) at the base of the dome reached the critical measure of about forty meters or more, like the diameter of the Pantheon,

or those of St. Peter's and S. Maria del Fiore's. A diameter of around twenty and thirty meters was already considered significant, so that one should assess carefully the vulnerability of the structure, and evaluate the risk of cracks.

The average diameter of the roman baroque domes is usually bound between twelve and twenty meters—the cupola del Gesù, one of the largest, measures about 80 palmi (17,87 m)—, while the height of the dome, including the lantern, ranges between fifty and sixty meters, or a bit more. In these cases the construction technique could easily follow the traditional path, although many problems challenged the erection of a dome of medium size. Those included the choice of proper and sound materials, the process of construction down to the right moment in which safely the inner timber centers should be freed, the high costs to afford, how to finance the enterprise, how to handle the question of a longlasting *firmitas*, applying some progress of the new science in order to achieve unexpected results in the work of art (Marconi, D'Amelio, De Feo in Conforti 1997). So, in spite of its improvements, Galileo's new mechanic was not substantially assimilated by the roman architects, even by those brilliant experts in mathematics, like the jesuit Orazio Grassi, the author of the never built dome of S. Ignazio.

In the sixteenth and seventeenth centuries the architect usually supposed the homogeneity of the material, conceived as not elastic, but rigid, and considered most of all the proper weight of the material, so that the thrust could be almost exclusively compressive. For example, the study of the lateral tensions, or the behaviour of the pendentives, spherical triangles which act as a transition between a circular dome and a square base on which the dome leans, were usually omitted. Iron, stone or even wooden rings were built in the orizzontal layers of the dome in order to contrast the lateral tensions.

The diameter of the dome, as we have underlined, was the main reference measure. The treatises of architecture generally avoided to explain in to details the practical side of the architecture on two main grounds: first because in the building-yards there were competent masters and skilled workmen that knew well by tradition their «*techne*», including the employment of innovative machines, mainly through

direct experience and oral information, second because the evolution from the medieval and renaissance heritage was extremely slow and for domical vaults of medium dimensions the traditional knowledge was adequate enough.

The question of the light

On the subject of the baroque theory on the domes' design we have to mention a lively debate on the way of lighting, which took place inside the Accademia di S. Luca, where Cortona, Principe in the period 1634–1637, had been teaching painting during his all life. There were two different positions: the first recommended the way of lighting in the manner of the ancients, through a round open eye cut-off at the apex of the dome masonry, as in the Pantheon, so that the light, falling from the top, could directly flow inside with changing rays' inclination; the second, supported by Cortona, maintained the manner of the moderns, through the lantern, with an indirect and diffused illumination. This fruitful discussion involved a broader controversy, originated in the field of the music, early in Florence with the Camerata fiorentina and Vincenzo Galilei, and spread in the field of the arts between the supremacy of the ancients over the moderns or viceversa. Pietro da Cortona and the roman baroque architects all applied the modern way for illuminating their built domes, while attempts to propose in some designs the Pantheon like system were not generally put in execution: in Milano the debate concerned the reconstruction of San Lorenzo Maggiore's collapsed dome, rebuilt in 1619 by Martino Bassi, and in Florence such a system was adopted for the Cappellone dei Principi in San Lorenzo.

The debate about the light—a dominant theme of the period, rich of theological and metaphysical meanings—was particularly worked out in connection with painting. The subject had been already treated, in particular way, by Leonardo in his theory of light, shadow and penumbra, and by Serlio in dealing with the transparent light. In Seicento, the new science and theory of optic and perspective contributed to develop this argument, which had received a particular attention on the wave of the revolutionary works of Tintoretto, Caravaggio and the new scenic art related with the melodramma.

Borrowing from the practice of painting the concept of secondary light, also Galileo focused his attention on the problem of illuminating, that later was analytically treated by A. Kircher, in his influential work *Ars magna lucis et umbrae* (1646). Once again, Galileo was leading the path in the theoretical field, with evident consequences in isolated works of art, as in the renowned case of Cigoli's *Madonna dell'Immacolata Concezione* in the Cappella Paolina (1610–1612), in which the lunar globe, in his increasing phase, appeared for the first time with the shadows and shapes observed by Galileo. The science of optics produced a new technology in the . . . observation of the nature, so that the artist was stimulated to make incursions on unexplored fields. New horizons opened up to the celestial observation through the telescope, while through the microscope it was much easier to investigate the marvellous details of the small living creatures.

Not only there was an influence of the science upon the art, but also viceversa, and especially the art of representation, the theatre, was essential in shaping the mentality of the time. Two were the main tools, aside from the music, that could persuade and stir an emotional response in the spectator: light and perspective, in motion. N. Sabbattini, *Pratica di fabricar Scene..* (1637,1638) illustrated thoroughly the deceptive plays of the perspective of infinite space in the stage, deeper enough to allow sometimes a double backdrop of the scene and the sophisticated tools, in order to manipulate artificially light and darkness (usually through oil lamps, candles or torches, and occasionally with the help of depicted glass in different shape, sometimes full of water, as Serlio already stated) in the theater, both in the auditorium and in the scene, preferably from hidden sources, as described also by J. Furtenbach the elder, *Mannhafter Kunst-Spiegel* (1663).

The interest of the architects of the time about illumination of the domes, and the seminal role attributed to the light and music in the post-tridentine churches appear evident, already with the cupola del Gesù and the connected process of design. The domes were the ideal theatre, a space of representation, where the eyes and ears of the spectators were caught in profound emotion and persuaded with celestial and spiritual experiences.

All these aspects should be considered in relationship to the specific architectural culture of the

time, remembering that Berrettini tried always to apply the three main vitruvian categories: *firmitas*, *utilitas* and *venustas*, among which often conflicting tensions could easily rise. Evaluating the extraordinary bright experimental and technical solutions adopted either by Borromini or by Cortona for building the vaults and the domes, while Bernini preferred more traditional systems, in baroque Rome we can distinguish two main streams in the practice of architecture, including the building systems, the first based on the lombardoticese tradition, the second on the tuscan one, to which belonged Cortona, who however was aware of the more advanced experimentation of the ticinese school.

About Cortona's domes, we select now two matters strictly interwoven: the adaptations and refurbishing of previous existing building, and finally the new constructions.

THE INTERVENTION OF CORTONA ON PREVIOUS BUILT DOMES

In the complex field of new qualification of pre-existent domes, Berrettini worked at the domes of S. Maria in Vallicella, between 1647 and 1651, and of the church of the agostinians, S. Maria della Pace, redecorated between 1656 and 1659. As far as it concerns the first intervention, designed to give light to the fresco decoration, commissioned to Berrettini, Pietro opened a range of oval windows at the bottom of the shell.

This solution changed the effect and the perception of the central space, enlarged by the glasses' transparency. The improved dome, wholly superbly depicted, became more graceful, floating on the light as if it were suspended in a void and, as sacred image, acquired a new emphasis, through a continuing spirited movement of light and shadows, and a dynamical *chiaroscuro*.

Indeed the interruption of the continuity of the material in an extremely weak peripheral area at the spring of the dome caused, within twenty years, local failure generated by overstress in the structure, so that Carlo Fontana had to study some devices, in order to solve the critical situation (Hager 1973).

For S. Maria della Pace's octagonal tiburio-cupola, Cortona chose to evoke the Pantheon, at which he was referring either in the short half oval portico in the facade, and in the aspect of the stepped outer shell, designed in the manner of the ancients (*a gradoni*).

To the remodelling of the exterior in this fashion not rare in Rome (we can mention, for example, S. Maria Scala Coeli by Giacomo della Porta), corresponds the redecoration of the interior, with stuccoed not structural ribs and octagonal coffers, with the heraldic symbols of Chigi and Della Rovere's noble families, patrons of the church.

The systematic adoption of metamorphic stucco in the decoration of the ceilings was characteristic of

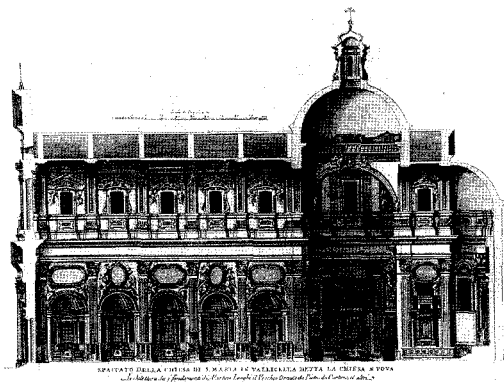


Figure 2
Rome, S. Maria in Vallicella: longitudinal section (from D. De Rossi, *Studio di Architettura civile* 1702–1721)

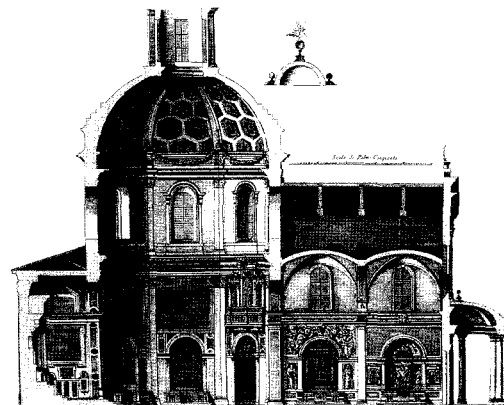


Figure 3
Rome, S. Maria della Pace: longitudinal section (D. De Rossi, *Studio d' Architettura Civile*, v III, Rome 1721)

baroque architects, who applied it in original experiments and solutions, in new buildings or in refurbishing old ones, with a rather low cost and prompt execution. Often the artists had the intention of creating illusory unforeseen effects, fictive surfaces and depths in space, imitations of artificial, fantastic or natural elements as clouds, or materials from the hard marbles or precious metals like gold, silver and bronze, to the soft tissues like curtains and even false objects. The need of a longlasting results implemented the study and application of various different methods to make a robust resistant stucco, through a choice of different constitutive elements. The yard-art of stucco developed in particular in the lombardo-ticinese tradition, but the masterpieces are connected with Bramante, Giovanni da Udine, Raffaello, Giulio Romano, Peruzzi, Cataneo, Sansovino, who gave a synthesis of the Lombardo-Veneto and Tuscan culture, till Pirro Ligorio, Aleotti and Maderno. Cortona, well aware of the new trend in the stucco-forte or marble-stucco (*scagliola*) decoration as a kind or substitution of sculpture, as did Bernini and Borromini, applied the stucco as a complementary part of his dome architecture, in order to create movement of elements in the interior drum and shell, inaugurating a more plastic conception of the geometry of the dome and in the meantime hiding the source of light in the attic, an effect that he achieved perfectly in the interior of Ss. Ambrogio e Carlo al Corso.

It is interesting to mention, among many chapels built by Cortona, the interior decoration of the vault of the cappellina of S. Filippo Neri in S. Maria in Vallicella. In this tiny chapel, executed according to a design of Cesare Guerra, for the first time Pietro Berrettini inaugurates a new style of ornamentation in the interior of a dome: the idea was to create an attractive contrast between ribs and coffered ceiling, using with sophistication the art of the stucco.

For its consequence on the Cortona's knowledge about the difficulties of domes' construction, we want finally mention the discussion about the way Borromini, who was later without much respect dismissed, handled the completion of the lanternino over the cupola of S. Agnese in Agone, mausoleum of the Pamphilj's family in Piazza Navona. As the documents reveal, Borromini didn't dismantle the armours (timber centers) because of some cracks that had already appeared in the structure, and waited too

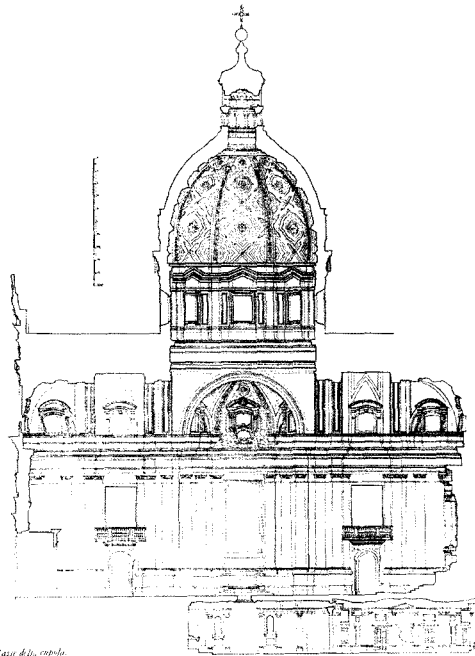
long time without giving explanation about the solution of the problem. Since we cannot go in to details, we mention only that Cortona was also summoned to give advice: The decision of a new commission was to lighten the structure of the dome, outwardly giving up the travertino in the drum, and internally the marble of the entablature, plus to postpone to free the dome from the armours, in order to complete all the masonry structure of the church at various levels, including the facade in the rear, on Via dell'Anima.

CORTONA'S NEW DOMES

We study now the domes realized by Berrettini *ex-novo*: in the first place, the dome of the church of Ss. Luca and Martina, started to be erected in 1634 and in process up to 1669, year of the death of the Cortona, and later finished by Ciro Ferri, the most faithful pupil of the Tuscan. In the second place, we investigate the dome of Ss. Ambrogio e Carlo al Corso, although we must specify that the pillars of the church of the Nazione Lombarda were already partly built. The dome was finally commissioned in 1668 and has been entirely designed by Cortona, although realized mostly after his death. The two domes, crowned with a lantern, are medium size (diameter around 14 m), and have a single shell, with a vertical oval curve profile. The shell, marked with external ribbing, is raised above an attic and a drum with clerestory windows. The materials employed in the masonry domes are travertino, a local porous calcareous stone, peperino, a harder stone, bricks, tevolozze, broken reused old tiles and with limemortar, in order to lighten the load of the structure. The domes, externally covered with layers of lead, in the peculiar roman tradition, are provided with encircling ties at the periphery, in order to counteract the lateral thrust and to prevent spreading.

SS. LUCA E MARTINA

About the dome of Ss. Luca e Martina, the church of the Pontificia Romana Accademia di S. Luca, in the Foro Romano, we don't recall the single phases of construction (Noehles 1970; Cerutti, Villani 2002, 68 ff.; 195 ff.). About the dome of the Nazione



coll'ase d'ito, cupola

Figure 4
Rome, Ss. Luca e Martina: longitudinal section (from Noehles 1970)

Lombarda church, dome built according to Berrettini's design, in about ten years after his death, we will give a brief account of the construction history, together with a description of the materials used and the specific technique of the structure.

In both cases we should notice that Cortona in his domes carefully studied the mutual relationships between the interior and the exterior shells: Pietro set up a sometime ambiguous interplay between ornament and structure, between dome and interior space of the church, between dome, urban and territorial significant interaction and view.

In alternative with the plastered flatness of the interior, predisposed, as in many cases in baroque Rome (from S. Maria in Vallicella to S. Agnese in Agone), for the fresco decoration, in his new built domes Cortona, even against the will expressed by many academicians in the case of Ss. Luca e Martina, refused the painted ceilings, merging instead two different traditional ways of vaults ornaments: the



Figure 5
Rome, Ss. Luca e Martina: view from the Capitol hill

first way was through coffers (*all'antica*), with the perspective effect of diminishing the geometrical pattern according to the form of the inner shell. Inspired from the example of the Pantheon, the coffers system had been already applied on the dome of the Sacrestia vecchia of S. Lorenzo, in Florence, by the «divine» Michelangelo, whose great authority was widely acknowledged, especially by Pietro. The second way was the internal plastic ribs, of long-standing tradition (again Michelangelo, or Antonio da Sangallo and Scamozzi, for example). In fact there had been already realized the combination of frescoes and internal ribs, which, provided that were not part of the structure, as in the Cupola del Gesù, sometimes have been even erased after the construction, to allow a full space for painting. The coffers and the ribs had

not yet been combined together until the dome of S. Filippo Neri. As authoritative scholars like Noehles (1970) and Benedetti (1980) have shown, the patterns of coffers represented by Cortona in his domes, like those of Borromini, were dense of Christological meanings, and exerted an enormous influence on countless works of that kind (documented since the first Concorsi Clementini in the Accademia di S. Luca). This new system introduced in the Chapel of S. Filippo Neri and later adopted systematically by Cortona was bound to become a paradigm, starting with Ss. Luca e Martina. A similar mixed system has been applied also by Bernini. He employed coffers shaped in geometrical forms, the octagon, with heraldic symbols, in the ceiling of S. Andrea al Quirinale, of S. Tommaso di Villanova in Castelgandolfo, and of S. Maria Assunta in Ariccia. Evidently Bernini was influenced by the taste of Alessandro VII, who intended to stress the heraldic arm of his family, as we can see as well in the interior dome of S. Maria della Pace. The choice of strictly geometrical shapes shows also that Gian Lorenzo inclined to expressions more in keeping with a taste *all'antica*, based on the model of the interior of Pantheon, for which he had studied a refurbishing with Chigi's armorial bearings. The same classical taste, probably suggested also by Pope Alexander VII, occurred for the external shape of the outer shell: both in S. Tommaso da Villanova and in S. Maria Assunta in Ariccia, built for the Chigi's family, the ribs were stressed in a less plastic and original way as in Cortona's works. Berrettini played with the not structural inner ribs overimposing different planes of ornaments and figures, so to suggest deceptively a deeper thickness and a higher cupola.

As far as the function was concerned, the way in which the light (*i lumi*) entered inside the dome depended also if the ceiling was decorated with a fresco, or with a sculptured either technical or purely ornamental system, such the inner ribs, more or less decorated. Cortona designed a coffered ceiling, in a mixed arrangement, made with stuccoed ornamentation, not only geometrical, but also symbolic, carved in plastic and meaningful complex. The manipulation of the light, a constant concern shared also by Bernini and Borromini, answered in fact to the specific function and significance of the space: in the case of the dome of Ss. Luca e Martina, Pietro chose to convey light from many sources,

diffused through various vertical levels. From the top we observe a very diaphanous lantern (more exactly one could say a cupola, in Italian cupolino) enough large and designed in a complex exotic, apparently bizarre, way (sometimes defined as bulbous cupola), the attic, in a way that from inside the dome the sources of light are not perceived, because are located so high or behind other elements, that are concealed or masked. As result in the interior the spectator could see, over the entablature of the inner drum, an additional flow of light. Cortona decided that the tall drum had to raise up completely out of the roof of the main nave, and that the dome should be well visible and evident, in relation to the façade: the question and the solution were not at all new, since they had been already discussed for S. Peter. Later the problem had been treated for the completion of S. Ignazio, around 1645, by Orazio Grassi, under the suggestion of many famous architects. In that occasion the Jesuit father recommended to adopt a particular solution, as a consequence of a variation from the proportions established in wooden model and in the approved paper design of the Church: since the height of the prospect and side walls of the building had been increased, a taller drum was needed, to prevent the dome to disappear to the sight (Bösel 1985, pp. 160 ss). This choice of a high drum was bound to produce an effect that Bernini did not approve from the esthetical point of view: the spectator had to bend and overturn the head in order to observe the dome from the inside.

In Ss. Luca and Martina a tiers of windows originally pierced the attic, but this solution caused cracks and a local pathology (called *pele*), so that the continuity of the wall's masonry had to be restored. This drawback had already been revealed in San Carlo ai Catinari, notwithstanding the bricks' arches of unloading (on the example of the Pantheon), made in the structure order to convey the thrust in the correct direction, over the supports.

The solution of limited flows of light coming from the attic was then applied successfully in Ss. Ambrogio e Carlo al Corso. Inside, the sources of the light were concealed, thanks to perspective reasons: on one hand the high drum obstructed the view, on the other hand the strong interior articulation of the columns, together with the projecting members of the order prevented the sight to distinguish the windows of the attic, so that the illumination of the cupola

deceptively produced the effect of a kind of dissolution or dematerialization of the space, that contrasted with the plastic allusive protrusion of the external ribs in the interior.

Particularly interesting was the debate about the resistance of the two already built pillars, emptied with lumachae stairs, that preceded the construction of the dome of Ss. Ambrogio e Carlo al Corso: it is clear how Pietro da Cortona, consulted as the most expert of his time about the «Theorica» (theory) of the domes, founded his conclusions on a rational analysis of seminal design criteria, both theoretical and practical, useful for building cupolas. The construction knowledge about the domes, in the first half of seventeenth century, has been in general underestimated, because it has been related from one side to the scarce production of specific technical

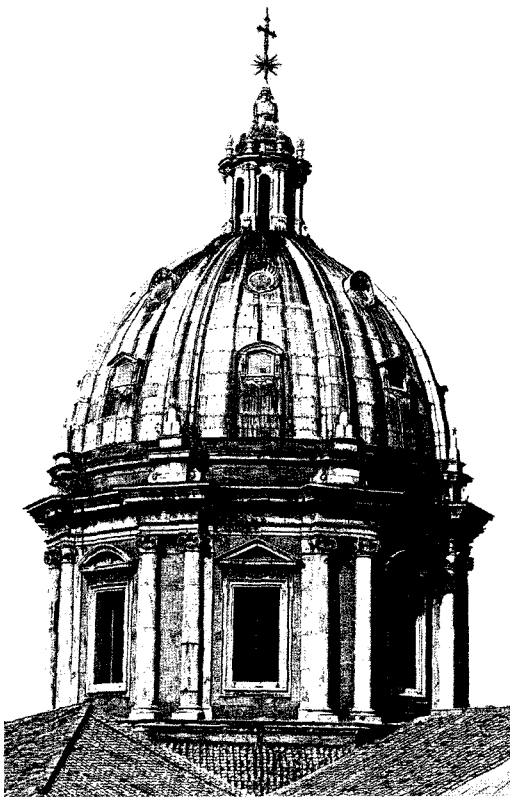


Figure 6
Rome, S. Andrea della Valle: dome



Figure 7
Rome, S. Agnese in Agone: exterior view, detail

literature, and on the other side to more advanced mechanical theories.

In Rome, except the double shell of S. Pietro, the domes with slender proportion and vertical shape, previous to S. Ss. Ambrogio e Carlo al Corso, were S. Giovanni dei Fiorentini (1612) by Carlo Maderno, S. Andrea della Valle by Carlo Maderno, completed by Borromini in 1621, S. Carlo ai Catinari (1612–1620) by the barnabita Rosato Rosati, Sant' Agnese (1657) by Borromini and Carlo Rainaldi, with the advice of the best experts, among which Pietro da Cortona (whose most faithful pupil, Ciro Ferri, painted the dome's ceiling).

In his built domes Cortona refused to pierce, as in San Pietro, Sant' Andrea della Valle and San Carlo ai Catinari, the outer shell with little holes which, though useful for the circulation of the air, evidently visually interrupted the curved line of the ribs and the compactness of the webs, diminishing the elegance of the whole urban image. Finally we can mention, if nothing else on the base of its proximity to Ss. Ambrogio e Carlo, S. Rocco's dome (around 1650), by G. Antonio De Rossi. In this last dome which, although very poor in sculptured element, was noticeable only for the large windows carved in the slender drum, De Rossi simply summed up the previous experiences, without expressing a work of art.

Moreover we can add to the possible reference for Ss. Ambrogio e Carlo al Corso's dome two jesuit churches: first of all the Gesù, by Giacomo della Porta (the author of the more successful dome of Madonna dei Monti), interesting for the inside more

than the rather awkward and heavy outer shell. For its large width it was carefully studied, as proved in the documents about S. Ambrogio e Carlo al Corso (D'Amelio 1997, 200–201).

In the second place we should recall the debate about the S. Ignazio in which Orazio Grassi played an important role. We cannot forget to mention the countless domes in Italy, most of all in Firenze, Milano (San Fedele most of all), Genova and Napoli. The south capital of the spanish vice-kindom in the Seicento was a meeting place of many crosscurrents, in which a particular relevance assumed the ecclesiastical architecture built by the Jesuit, Barnabite and Theatine, especially in Rome, although the local traditions, for example in Napoli the polychrome majolicated covers of the domes, were profoundly different from the tuscan, ticinese and roman. In Napoli we recall, as possible references, the works of F. Grimaldi, Fra Nuvolo and

most of all Cosimo Fanzago, who was active also in Rome.

Ss. Ambrogio e Carlo al Corso

Designed probably in the summer of 1668, and realized during the following four years, Ss. Ambrogio e Carlo al Corso's dome can be considered as one of Pietro da Cortona's masterpieces, as well as his last great work (Boido et alii 1987; Villani 1997; Cerutti Fusco, Villani 2002).

The finishing works of the church (transept, presbytery, apse, deambulatory and dome) realized by the Main Confraternity of *Nazione Lombarda* (Lombard community) began in 1665. By the end of 1668, they were completed, except the façade and the dome. Pietro is mentioned as the author of the project of the dome in an original document (September 1668). On the architect's death (16th May 1669), only the lower part of the drum had been built; however, the whole dome was realized according to Cortona's



Figure 8
Rome, Ss. Ambrogio e Carlo al Corso: dome, exterior view

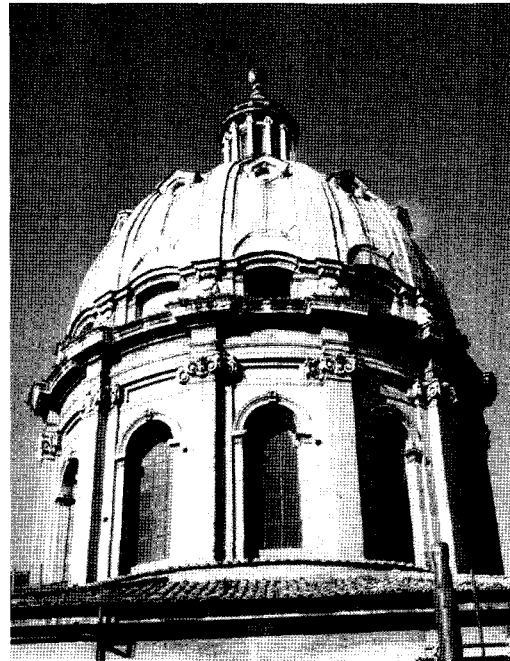


Figure 9
Rome, S. Carlo ai Catinari: dome, exterior view

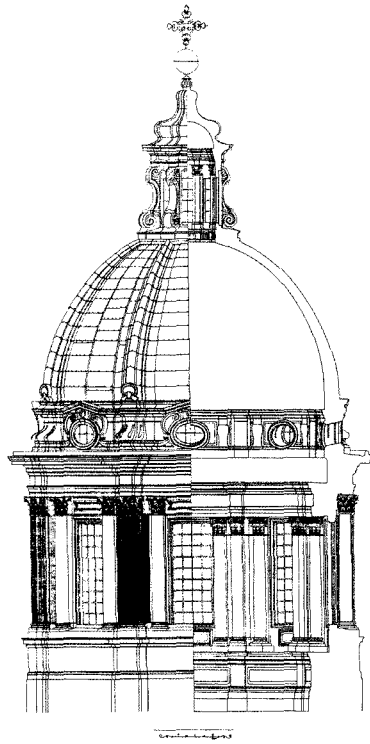


Figure 10
Rome, Ss. Ambrogio e Carlo al Corso: dome, front-section
(from Boido, Mestrinaro, Tamburini 1987)

design, under the leadership of Tommaso Zanoli, the Confraternity's architect.

Starting from Rosato Rosati's S. Carlo ai Catinari (1612–1620), Pietro da Cortona designed such a «transparent» structure, with huge windows and no extended walls in the drum.

The adopted scheme was possible by concentrating most part of thrusts in eight cross-shaped brick pillars, with the little contribution of the contiguous columns (four for every pillar).

The arches which discharge the weight of the lantern and the shell to the pillars are hidden under the metal plating of the dome, unlike Rosati's dome, in which they are visible. Under the arches, between the drum and the shell, Cortona opened eight oval windows, increasing the inner lighting.

The presence of stone elements is extremely limited: a portion of the great basement of the drum, the inner and outer bases, and the capitals of columns and pillars.

Except for the ribs, the shell is entirely built with *tevolezza*: a mixture of incoherent bricks and lime-mortar, it can be regarded as a light, but sufficiently resistant material, the use of which was widely diffused in XVII century Rome (Bertoldi et alii 1983; Scavizzi 1983; Cirielli 1987). Of course, the stone is largely replaced by bricks and *tevolezza* to obtain a lighter structure. A great «cerchione di ferro» (iron ring), whose weight is about 1250 kilos,

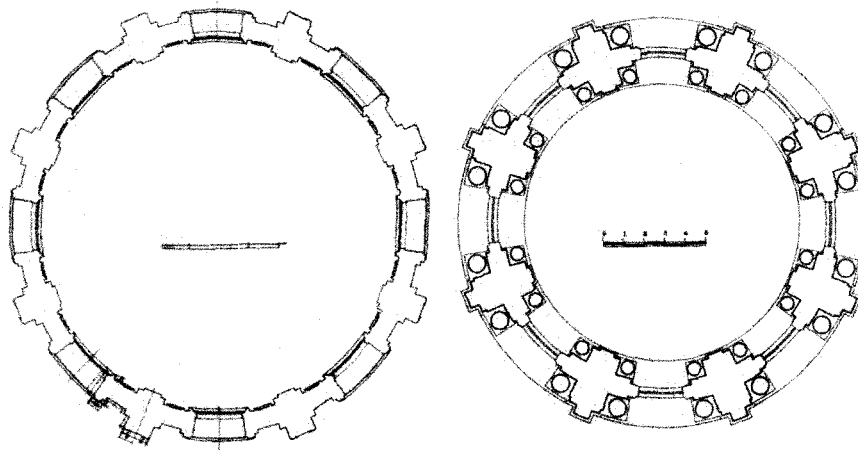


Figure 11
Rome, Ss. Ambrogio e Carlo al Corso: dome's plan, in comparison with Ss. Luca e Martina's one

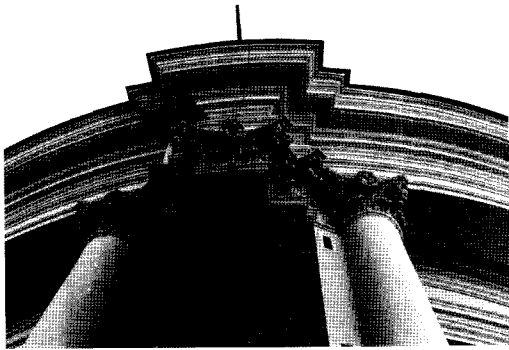


Figure 12
Rome, Ss. Ambrogio e Carlo al Corso: dome, detail of the drum

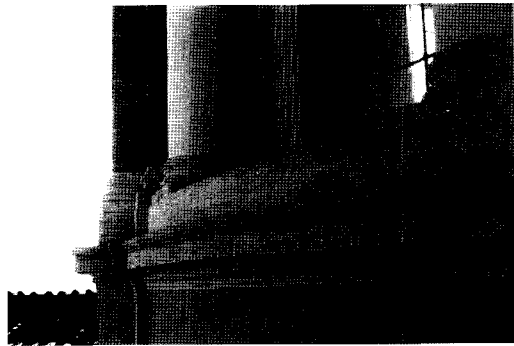


Figure 13
Rome, Ss. Ambrogio e Carlo al Corso: dome, detail of the drum

is walled up, probably next to the impost of the dome.

The covering of the dome is made by lead slabs, according to the typical Roman tradition. Each piece—whose weight is about 5–6 Roman *libras* for *palmò quadrato* (cmq 500; every *libra* = 327g)—is fixed by lead nails.

Traditionally associated with the façade of S. Maria in Via Lata as an exemplification of Pietro da Cortona's late classicism, Ss. Ambrogio e Carlo's dome is a coherent step of the architect's evolution towards a more essential language. In this phase, the architectural order stands as the chief element in the composition; for example, the great windows of the

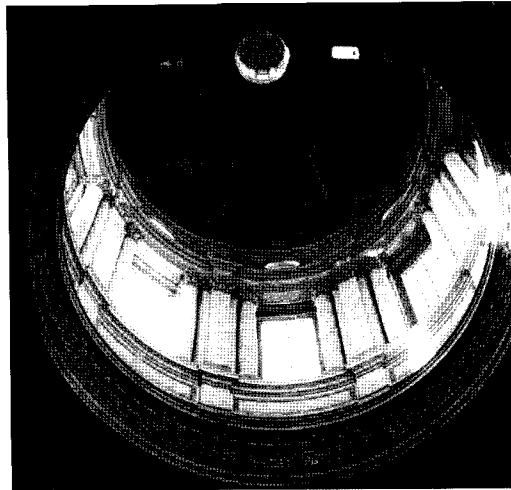


Figure 14
Rome, Ss. Ambrogio e Carlo al Corso: dome, interior view

drum, delimited by simple mouldings, present no decorations.

The main outcome of the lightening of the dome and the great enlargement of the windows of the drum is the impressive amount of the rays of light from outside into the inner space; from this point of view, the dome has no equals in Rome.

In this last masterpiece Cortona pushed the construction technique to its limits, when he made thinner the webs, in order to shape the exterior surface through a plastic multiplication of ribs, whose section instead of flat is unusually rounded, according to a hierarchy (Cerutti, Villani 2002, 119 ff.; 311 ff.). Furthermore he gave greatest prominence to the design of the light modulation. For this scope, Berrettini reached the valuable result of erecting at the drum level, in contrast with the opacity of the outer shell, a diaphanous openwork structure that, thanks to the wide windows, was reduced to an evident skeleton, an impression enhanced by the attic with clerestory. The drum is only apparently thin, because the thickness of the compact cross section is balanced between outside and inside. The spectacle of the verticalized dome, completely isolated from the roof of the church and transparent to the light from one side to the other, was perceived as unusual and audacious. Due to the urban environment at the time

of its construction, the dome dominated more from distance than from the vicinity of the church. It is a *Gesamtkunstwerk* of sculptured architecture, in which a perfect equilibrium is achieved by Cortona: his ideal architectural testament.

One of the biggest in Rome, Ss. Ambrogio e Carlo's dome stands out as the perfect conclusion of the roman baroque evolution of the architectural theme. Although admired and studied all over Europe—and especially within the Accademia di S. Luca—owing to its originality, Ss. Ambrogio e Carlo's dome will remain with no evident imitations in Italy, except for the Neapolitan church of Spirito Santo (Holy Spirit): a XVIII century work by M. Gioffredo.

Conclusion

Introducing many sometimes hazardous novelties in the technique of construction, not without difficulties and danger for the stability and with serious risk for

their own safety, prestige, and for legal and economical consequences, on personal or institutional grounds, the three masters of roman baroque bravely experimented different original types of domes: from the more traditional, like S. Maria Assunta in Ariccia by Bernini, to the absolutely rivolutionary one, like Sant'Ivo alla Sapienza, by Borromini, to the brilliant novelty of Ss. Ambrogio e Carlo al Corso by Cortona.

The innovative aesthetical, technical and structural results obtained in such a singular and bold work of art, built by Cortona in his declining years, merge in an original impressive and stimulating architectural and urban image. The meaning of Cortona's efforts was to conceive the domes as a whole sculptured object of art, both as inside and outside, in which lightening has a central role, enhanced by the impressive reduction of the structure to a skeleton. The model elaborated by Cortona will become a paradigm for many generations of architects engaged in the construction of baroque and rococo domes throughout Europa.



Figure 15
Rome, Ss. Luca e Martina: dome

NOTE

The theory; The intervention of Cortona on previous built domes, Cortona's new domes (Ss. Luca e Martina) by A. Cerutti Fusco. Cortona's new domes (Ss. Ambrogio e Carlo al Corso) by M. Villani. The remaining parts are by both authors.

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