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On the art and the culture of domes. Construction in Milan and Lombardy in the late sixteenth and in the first half of the seventeenth century

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In absence of objective and universally accepted knowledge of statics, the construction of domes seems to have represented, until at least the end of the XIX century, one of the most difficult problems for architects and builders.

The moment of the undertaking of domes —apart from the formal and the expressive purposes, the selected geometry and the building techniques, the involved human and economical resources— often led architects, owners and building yards to cautious pauses, that could even last centuries, implying the re-examination of the original plans, or sometimes the reconsideration of what was already built, or even the settlement of completely different projects.

The large number of damages and the frequent ruins of vaults and domes that marked the course of architecture in history testify the objective difficulties met by the builders in the comprehension of the behaviour of those coverings. The builders were supported only by practical experience and uncertain sizing rules, mainly of geometrical kind, that varied according to the problem they had to deal with and to the cultural environment.[1]

This lack of homogeneity made systematic studies about domes planning and building very difficult, and such a study is currently still missing in regard to the areas of Milan and Lombardy.[2] In this context, the present work considers as a starting point the vicissitudes —very important to the architectural debate in Milan— concerning the reconstruction of the dome of the early christian basilica of S. Lorenzo,[3] ruined in 1573 and re-planned by Martino Bassi, figure 1, and the dome of the church of S. Alessandro, built in 1626 by Lorenzo Binago and demolished in 1627,[4] figure 2.

Through the examination of the archival documents, the proposed plans and the executed interventions in these two milanese buildings, the present paper intend to fulfil a first general outline of the planning aspects, the construction practice and the understanding of the behaviour of masonry domes in Milan architecture between the second half of the XVI and the first half of the XVII century.

During this historical period, that largely coincides with the counter-reformation activities promoted by

Figure 1
Milan, S. Lorenzo, back view of the church.

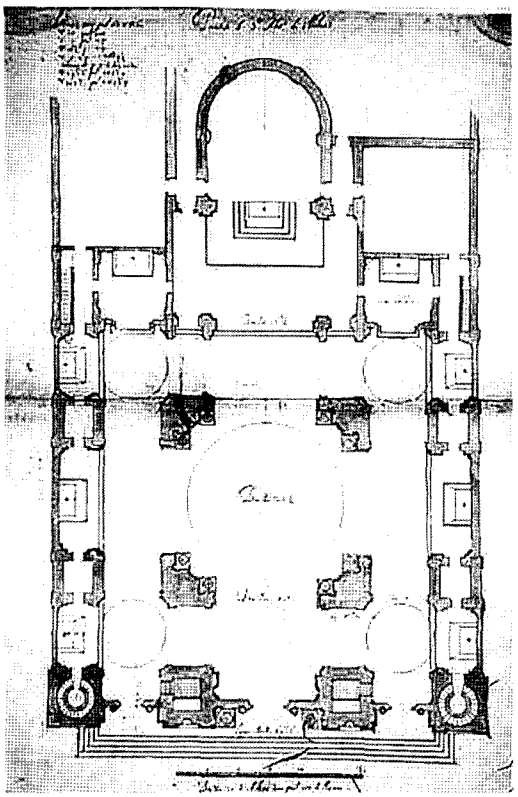

Figure 2
Lorenzo Binago, ground plan of S. Alessandro, 1602, Milano, Archivio Storico Civico, Raccolta Bianconi, VII, 6.

the archbishops Carlo and Federico Borromeo, many building yards of important churches in which domes were foreseen to cover the ecclesiastical plan system, or its most significant spaces, were opened in Milan.

According to a habit deeply rooted since late antiquity, the local architectural culture preferred, rather than the extradoxed domes, the solution, so traditional as to be called «alla lombarda», of the dome covered by «tiburio», crowned or not by a lantern.

Limiting our observations to the context of Milan and recalling only the most famous examples, domes with «tiburio» may be found in many late antique buildings, such as the S. Aquilino chapel in S. Lorenzo (and probably the original dome of S. Lorenzo itself), in the carolingian sacellum of S. Satiro, in the romanesque church of S. Ambrogio and in many other buildings belonging to the mediaeval period.

During the Renaissance, the «tiburio» solution was again widely adopted, preserving the inherited mediaeval building tradition and classically renewing its architectural language. The structural and stylistic problem of the «tiburio» of Milan cathedral, left then unsolved, raised an ample debate in 1487–88. In that occasion, in addition to the local builders, also Bramante, Leonardo, Francesco di Giorgio were invited to propose a plan. Bramante, who would have designed in Rome, for St. Peter, a partially extradoxed dome recalling the model of the Pantheon, in Milan covered with «tiburio» the domes of the church and of the sacristy of S. Maria presso S. Satiro, and the dome of S. Maria delle Grazie. Between the end of the XV and the first half of the XVI century, the «tiburio» was used in all the major religious buildings in Milan: among the most important those of S. Maria presso San Celso (begun by Dolcebuono in 1497), of the Trivulzio chapel in the church of S. Nazaro in Broglio (begun by Cristoforo Lombardo, ended in 1547), of S. Maria della Passione (begun by Cristoforo Lombardo in 1549–50), figure 3, of S. Vittore al Corpo (Vincenzo Seregni, 1559; ruined and rebuilt by Pellegrino Tibaldi, 1568–about 1573) may be recalled

Since the late Sixties of the XVI century, in Milan, the tradition of «tiburio» begun to encounter a first crisis. The influence of the roman architectural trends, that proposed the partially extradoxed dome – connected to the model of Pantheon and of the Bramante's plan for St. Peter —as well as the entirely

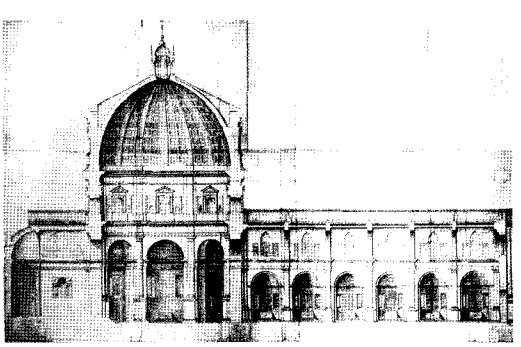

Figure 3
Milan, cross section of S. Maria della Passione (1549–50).

extradoxed dome— connected to the model of Michelangelo's St. Peter —gave rise to the first openings that introduced in the local architectural culture a strong dialectic between tradition and change.[5]

It is likely that the first wide use in Milan of the extradoxed dome, crowned by a lantern and superimposed on a drum with windows was due to Pellegrino Tibaldi. He actually proposed this kind of solution in S. Fedele (1568–69), figure 4, in S. Sebastiano (1578–1586) and in the Sanctuary of Caravaggio (1571), even if he did not disdain the «tiburio», used for example in S Vittore al Corpo.[6] Around 1590, the projects designed for S. Lorenzo dome still wavered between the «tiburio» and the extradoxed solution. During the first half of the XVII century many domes with «tiburio» were still planned, such as the dome of S. Alessandro, built by Binago, figure 5, and almost every dome built by Francesco Maria Ricchino, one of the most important architects in Milan in that period. Nevertheless, Ricchino seems to have made a few exceptions in some plans, left unexecuted, such as the one provided for the dome of S. Alessandro, designed following the roman style (1629–30) (Giustina, 2002), *figure 6*. In contrast, it could happen that extradoxed domes were covered with «tiburio», as occurred to Tibaldi's dome of S. Sebastiano (Fabio Mangone, 1628).[7]

The incapacity to take a definite direction was probably due, besides the aesthetic problems, to the great structural difficulties related to the new types of domes. Lombard architects and builders were actually scarcely familiar with the new structures and with their statics. Their worries especially increased in presence of a dome supported by four main arches and pendentives, superimposed on four free-standing pillars. That was considered in the past one of the most difficult engineering problems, and that was the kind of structure that could be found in S. Lorenzo, with a late antique 'double envelope' plan, figure 7, and in S. Alessandro, with a *quincunx* plan, figure 2.

The study of the documents regarding S. Lorenzo and S. Alessandro[8] makes clear that one of the main problems of the builders was the determination of the size of the piers in relation to the evaluation of their strength. The debate on S. Lorenzo dome proves that at the end of the XVI century it was intuitively very clear for milanese builders that the pillars should basically resist to two different kinds of stress, ensuring strength to the superimposed weight, that is to compression and bending, as well as to the thrusts of the dome, that is to tilting.

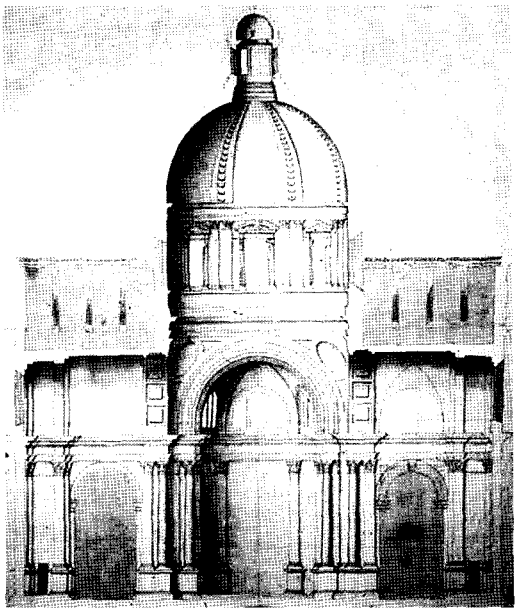

Figure 5
Lorenzo Binago, transverse cross section of S. Alessandro, 1602 (?), Milano, Archivio Storico dei Barnabiti, Cartella Grande I, mazzo I, fasc. III.

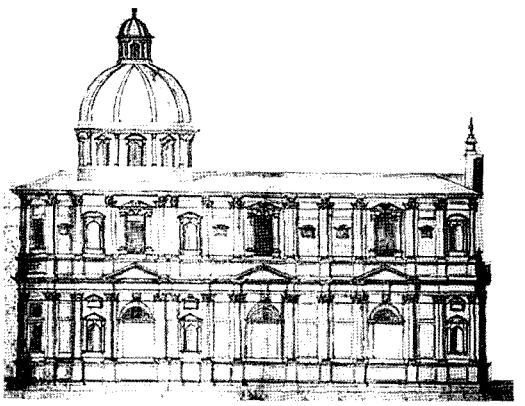

Figure 4
Copy of Pellegrino Tibaldi's project of the side of S. Fedele in Milan. Milano, Archivio Storico Civico, Raccolta Bianconi, VI, 12.

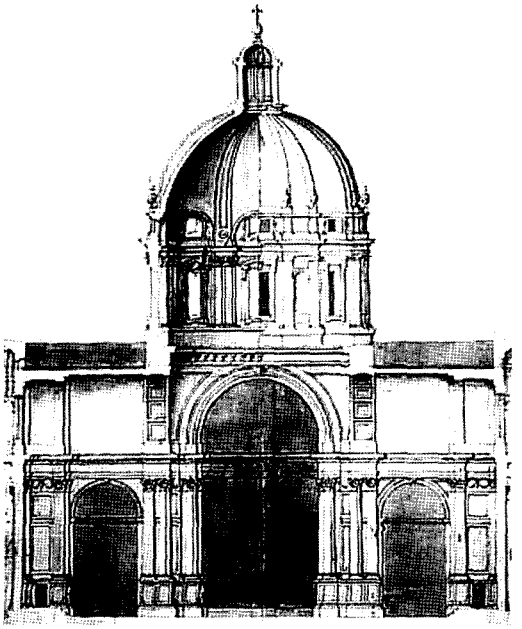

Figure 6
Francesco Maria Ricchino, transverse cross section and partial front view of the new dome of S. Alessandro, unexecuted project. Milano, Archivio Storico Civico, Raccolta Bianconi, VII, 13.

The builders tried to solve the problem of resistance to compression and bending, which could arise «per la grandezza materiale del peso al ingiù quando la forma, et la matteria del resistente, no' superasse il soprapostovi di forza»[9] (because of the great vertical weight in presence of inadequate buttresses), by the choice of appropriate building materials and techniques. In S. Lorenzo Bassi reconstructed the ancient masonry pillars covering them with squared local stones, «ceppo» and «serizzo».[10] The certainty of the stones being higher in strength than the bricks was justified by the firm belief that the strength of materials was proportional to their weight, and so «il ceppo è di forza maggiore del cotto, nella proporzione che è più grave del cotto».[11] The documents regarding the dome of S. Alessandro furthermore show that the builders were also concerned about the bonding of the building materials that formed the pillars. Binago recommended to wall up well and to connect by iron

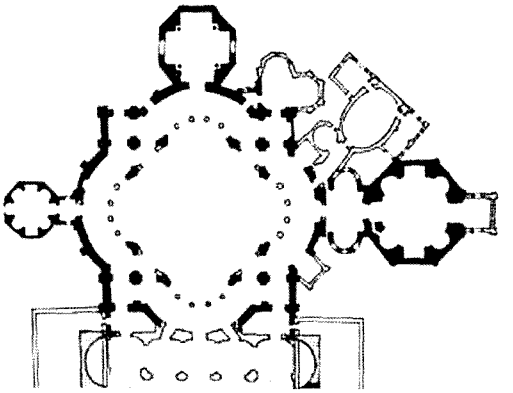

Figure 7
Milan, S. Lorenzo, ground plan.

cramps the marble covering blocks with the masonry core, «ben murati et incambrati con grappe di ferro».[12]

The rule, observed by Bassi, for the size of the height of S. Lorenzo pillars according to the superimposed weight seem to be rather curious: Bassi tried to get over the doubts of the supervisor of the yard, Guido Mazenta, with the assumption that the strength of the piers should be related to the number of the architectural orders that could be superimposed on them, diminishing the height of the orders «in sesquiquarta porzione », that is by 5/4.[13] However, this assumption —as Bassi was told by the roman architect Tolomeo Rinaldi, supported by Mazenta—[14] could neither be found in architectural treatises nor in ancient architecture, and it seems that Bassi used this rule as an expedient to ennoble a personal building criterium and to make up for the incapacity of calculating strength with the authoritativeness of antiquity.

The hint at the «motto laterali o' da archi o' dalla cuppola, quando no' havessero li resistenti, et li incatenamenti bisognevoli»[15] (literally, the sidewise movement of arches and domes in case of inadequate buttressess and ties) makes clear that on the ground of a right structural intuition, based on experience,[16] in the architectural culture of the second XVI century the behaviour of vaulted structures and their spread, which would tilt the piers in absence of adequate buttresses and ties, was well known.

In S. Lorenzo the four towers that were at the corners of the square plan —«li muri che li

contrastano in linea retta formando il quadrato che serra e include tutta la struttura e che forma le torri»— were considered by Bassi as the main buttresses of the domed core. For this reason, the architect planned to reconstruct them stronger and, above all, taller than before «non solo nelle parti reputate guaste ma anche fino all'altezza della cupola, come dal progetto stabilito (. . .) per assicurare ed abbellire l'esterno della fabbrica»[17].

It is widely known that the use of ties —although openly criticised by official architectural culture and taken, even by Bassi, as a reason to criticise what Tibaldi had done in the baptistery of Milan cathedral— was never neglected in building practise (Della Torre, 1990). At the same time, it was also considered that the most positive effect of chains, were they iron made or wooden, placed in the intrados or in the extrados of vaults, could not be obtained without an excellent workmanship brickwork. Only in this way it could have been assured the best behaviour of masonry, which, bonded at its best, would have thus turned into a homogeneous, and therefore resistant, material.[18]

In S. Lorenzo Bassi made a wide use of «incatenamenti apparenti e nascosti» (visible or hidden ties) to contain the thrust of arches and vaults, significantly called «motto espulsivo» (expulsive movement), and he foresaw hoops in the dome, stating that the dome «ben fabbricata, et ben coligata . . . haverà più motto o' sia gravezza all'ingiù concentrandosi meglio, che espulsivo o' al infori»[19] (the dome well constructed and encircled by hoops would will exert more vertical than horizontal forces), figure 8. In S. Alessandro the lack of adequate ties was considered one of the main reasons of the failure of the domed structure executed by Binago, and the reconstruction projects of the structure, proposed by Ricchino, show that an ample use of iron ties was foreseen at the extrados of the four main renewed arches to connect them better with the pillars, figure 9.

The debate regarding S. Lorenzo, moreover, brings to light the doubts that builders had in determining the size of a dome section and its curvature, and shows that they probably realised by intuition the existence of a relation between the section of the dome and its span. The supervisor of the yard, as a matter of fact, asked Bassi whether the thickness as few as «oncie 15 o 18» would have been adequate in relation to a dome «di 40 braccia di diametro et alta alla proporzione».[20] Bassi was also asked to assert which kind of dome should have been better to build in relation to its geometry and building techniques. He was actually asked if it was preferable «fare la calotta di terzo acuto, di quarto acuto, mezzo tondo» (differently pointed) and « farla doppia o semplice» (double or simple), and the questions prove that the building culture was aware of the different behaviour of these types of dome.

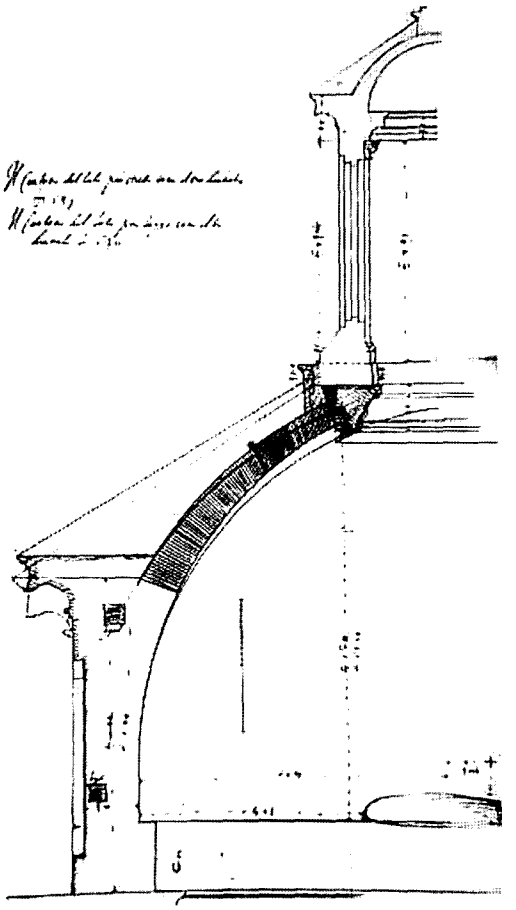

Figure 8
Francesco Maria Ricchino, partial cross section of the dome of S. Agostino in Milan with two wooden inner hoops (1614–18). Milano, Archivio Storico Civico, Raccolta Bianconi, IX, 24.

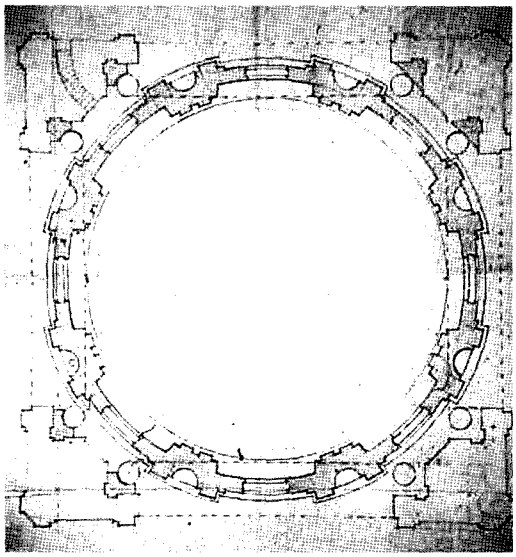

Figure 9
Francesco Maria Ricchino and Giovanni Ambrogio Mazenta, plan of the new dome of S. Alessandro, with iron ties (1629 ?). Milano, Archivio Storico dei Barnabiti, Cartella Grande I, mazzo I, fasc. III.

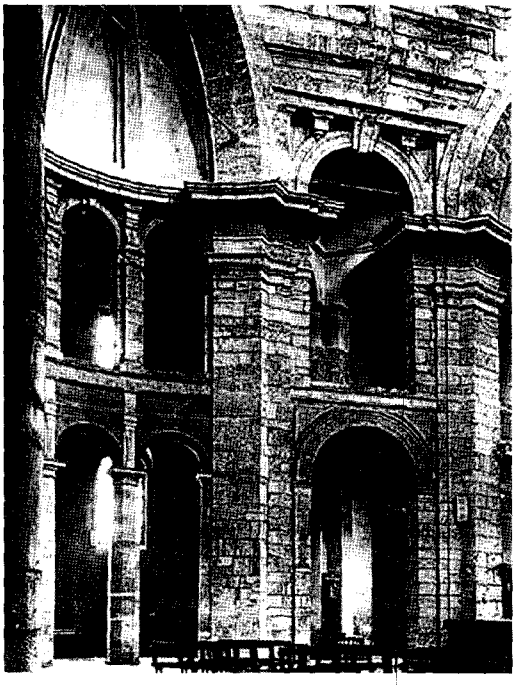

Figure 10
Inner view of S. Lorenzo, one of the tripartite pillars.

The knowledge of the higher thrust exerted by a round arch compared to a pointed one, and implicitly the knowledge of the empirical rule that the spread of an arch is inversely proportional to its height, was common sense at that time. Since the late XV century, when in Milan the semicircular arch begun to be preferred, domes were often planned with a round curvature but, probably because of their worse behaviour, they gained little success. For S. Lorenzo dome it was decided a fairly pointed curvature, figures 10–11, despite many projects had proposed a round one. The case of S. Alessandro dome is particularly interesting. The first dome —built by Binago with «tiburio» and resting on a drum, demolished a few months after the construction because worrying cracks had appeared— probably had a round curve. The new dome, planned by Ricchino in 1629–30, was extradoxed and rested on a drum, following the roman trends; nevertheless, the pointed profile of the dome, thought safer, would have not been visible, because it would have been covered by a wooden structure with semicircular

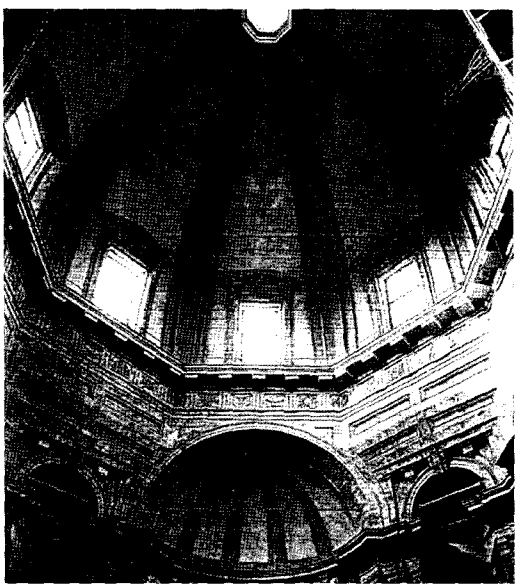

Figure 11
Inner view of the dome of S. Lorenzo.

profile that would have ennobled the external design of the dome, figure 6.

It is not improbable that even the long-lasting use of «tiburio» was justified, besides economical reasons, by the fact that most of the domes had a pointed profile. They were certainly considered safer but, since the birth of Renaissance, they were also considered barbarian, against the rules of antique architecture and therefore they had to be concealed. This problem may be testified by the superimposition of a «tiburio», around 1628, on the dome of S. Sebastiano, designed by Tibaldi with a pointed visible extrados.[21] As it is suggested by recent structural studies regarding S. Alessandro,[22] the superimposition of a «tiburio» particularly on domes whose impost is misaligned with the piers —just the case of domes resting on four free-standing pillars— does not seem to improve the performance of the domed structure. The «tiburio», in this case, though playing a stabilizing role of the 'orange slices' into which the dome typically breaks (Heyman, 1967), acts in a negative way on the whole dome structure. The «tiburio» may be considered, as a matter of fact, as an increase of the weight resting on the pillars, possibly causing an increase of their bending stress and tilt.

It is very difficult to find in archival documents some notice about the determination of the size of the piers in relation to their resistance to the tilts caused by the thrust of the vaults, but it does not seem that in the historical period here considered there were any widespread observed rules on this subject in Milan. Bassi and other architects in S. Lorenzo took into consideration the increase of the pillars section, transforming the original tripartite pillars into massive pillars with a triangular plan, but the changes were not executed. Binago, in S. Alessandro, seems to have observed a personal building criterium to guarantee the steadiness of the dome structure, suggesting to design the cathetus of the triangular pillars as long as a half of the span of the arches that joined the same pillars, figure 12. It is possible that Binago adopted this rule because he wanted to reproduce the proportions observed in the plan of the Bramante-Raffaello project for S. Peter in Rome, published by Serlio (1619, III, 64–65), but it seems more likely that he used this rule as a consequence of a misinterpretation of the first symmetry principle based on the first postulate of Archimedes, surely known in Milan during the first decades of the XVII century (Giustina, 2002).

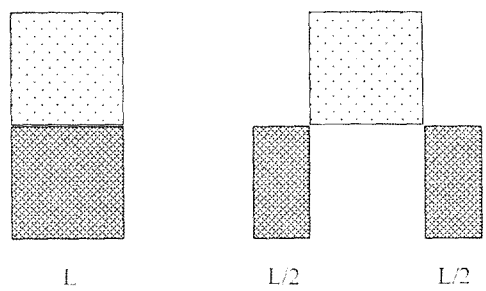

Figure 12
Scheme of Binago's rule of sizing the main pillars of S. Alessandro (author's).

The problem of the relation between the dome and the pillars was probably one of the most remarkable, because it involved the more general subject of the stability of the whole domed structural core. This relation was particularly critical in case of domes sustained by four free-standing pillars with the interposition of four main arches and pendentives.

Again, the debate on S. Lorenzo is very interesting. The dome firstly designed by Bassi was octagonal, pointed, partially extradoxed because of the presence of an external columned ring at the haunches.[23] The dome was connected to the tripartite pillars by four main round arches and four pendentives, which corresponded to the diagonal sides of the octagon and rested on minor arches connected to the pillars. The debate that arose on Bassi's plan in 1589–90 and the several different plans that were designed show that, besides the stylistic problems, the builders were very concerned with the domed core of the church. The supervisor of the yard asked Bassi whether it would be safe to rest the diagonal sides of the dome «sopra il vuoto dell'arco e fuori del dritto del pilastro»[24] (above pendentives resting on the void of an arch and misaligned with the pillars below).

A correct structural intuition, on which recent structural studies shed a first light,[25] made the builders fear that severe structural damages could be caused by the misalignment of dome impost with the piers. The different attempts at solving that problem can be easily seen through the plans, alternative to those of Bassi, proposed for S. Lorenzo. As a matter of fact, there were proposed projects in which the

octagonal dome rested on reinforced triangular pillars whose diagonal sides were prolonged up to the impost of the dome;[26] in this way the use of pendentives was avoided, as well as the misalignment between the impost of the dome and the pillars. Other plans[27] proposed circular domes resting, with arches and pendentives interposed, on triangular pillars, endowed with powerful free-standing twin columns along their diagonal sides. In this way, the pillars recalled those designed by Bramante for St. Peter in Rome (drawing Florence, Uffizi 20A) – and this was certainly one of the aims of the designers – but it should be noted that the twin columns, and in addition the doubling of the main four arches, were certainly introduced because they were supposed to help in reducing the problems given by the greater misalignment between the dome and the pillars.

The plans of a circular dome, proposed even by Bassi,[28] figure 13, were rejected and an octagonal dome was chosen. This kind of dome was probably supposed to give the structural core more guaranties of stability than a circular one, which was thought as a matter of fact, on the model of the Michelangelo's dome in St. Peter, « maggiormente in aria»[29] (more resting on empty).

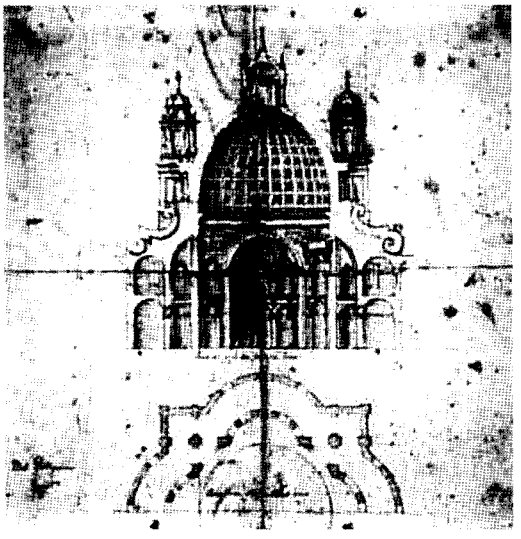

Figure 13
Martino Bassi, transverse cross section and partial ground plan of S. Lorenzo, unexecuted project. Milano, Archivio Storico Civico, Raccolta Bianconi, IV, 24.

Further complications to the relations between dome and free-standing pillars were also caused by the presence of a drum. Bassi does not seem to have foreseen a drum for S. Lorenzo dome, but many of the architects who proposed alternative plans did. The drum too did not belong to lombard architectural tradition and it begun to be considered (as in some plans for S. Lorenzo with a partially or an entirely extradoxed dome) or built (as, for example, in the domes of S. Vittore al Corpo, S. Fedele, S. Sebastiano designed in Milan by Tibaldi, or in the dome of S. Alessandro designed by Binago) wishing to follow the roman and the central Italian architectural trend. But, though solving the lighting problem, the interposition of a drum between the dome and the piers in case of free-standing pillars jointed by main arches, and particularly in presence of hemispherical domes, caused to the structure even greater problems.

As structural studies regarding S. Alessandro show,[30] the drum was actually exposed to the greatest strains at the base, in correspondence of the main arches, and at the same time, being an additional weight, possibly caused a dangerous increase of tension stress in the key stone of the arches leading them to collapse. This may have been one of the main reasons of the failure of Binago's dome, and even the archival documents seem to indicate that the largest cracks were mainly observed in the arches and in the base of the drum, while no mention to dome cracks was found (Giustina, 2002).

In conclusion, the problems examined in the present paper seem to show that the study of domes planned or build in Milan during the last decades of XVI and the first half of the XVII century has to be firstly related to the dialectic between the «tiburio» and the extradoxed dome, that is between lombard tradition and central Italy novelty.

The examination of this debate, and in particular the attempt of introducing up to date architectural trends, has allowed to shed a first light on construction practice and on builders' knowledge of the static behaviour of masonry domes.

As a result, this analysis, suggests that the study of domes can not be carried out, as too frequently happened, only considering aesthetic aspects or symbolic meanings, because, especially in presence of such challenging structures, formal choices were strongly conditioned, if not entirely determined, by the solutions given to structural problems.

ACKNOWLEDGEMENTS

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NOTES

1. On widespread geometrical knowledge and rules, such as «Blondel's rule», see Mainstone (1968); Benvenuto (1981, 323–324); Heyman (1982, 59–62); Castellano, (1989); Di Pasquale (1996). See also the numerous suggestions about the determination of the size of the main elements of domed structures expressed by Vitruvius, and cited again, with some changes, in the treatises of the XVI century; see S. Serlio (1619, 202–220); Tibaldi (1590[1] ca.; 1988, 162–164). For this subject and for further references, see also Conforti, ed. (1997).
2. On the problems related to the determination of the size of the structures of Milan cathedral, see Ackerman (1991).
3. The church of S. Lorenzo belongs to the late IV century. It has a square, two storey double envelope plan with four apses, with a central dome supported by four pillars, each one composed by three smaller pillars joined by arches and vaults to form a nearly triangular pier. After the ruin of the original dome in 1573, Martino Bassi was called to reinforce the structures left behind and to build a new dome. Following the project approved in 1577 by the archbishop of Milan Carlo Borromeo, the works stopped when it was time to build the dome. The supervisor of the yard, Guido Mazenta, with the roman architect Tolomeo Rinaldi, doubted that the projected dome would be steady and in 1589–90 opened an ample debate that brought to the fulfilment of many different plans. Bassi's project was only partly modified and the dome was built within 1619. The dome, still existent, was octagonal, pointed shaped, with windows opened at the impost and with a partially visible extrados, hidden at the impost by a columned ring. On the debate, the proposals of new plans and the related bibliography, see Rocchi Coopmans de Yoldi (1991); Scotti (1999).
4. The church of S. Alessandro was begun in 1601 by the Barnabite monk Lorenzo Binago and it had a *quincunx* plan. The main central dome was built in 1625–1626 and it was probably hemispherical, covered by a «tiburio», and was superimposed on a drum with windows; it was joined to the four pillars below by four roman arches and four pendentives. The pillars had a triangular plan with two free-standing columns along the diagonal side. The dome was demolished in 1627 because serious cracks had appeared. After the reinforcement of the pillars and the arches, planned in 1629 by Fabio Mangone and executed probably by Francesco Maria Ricchino, it was planned a new dome, pointed and with entirely visible extrados, resting on a windowed drum. The plan, designed by Ricchino in 1629–1630, was not executed, and a new extradoxed dome was built in the second half of the XVII century by Giuseppe Quadrio. See Giustina, (2002); *Lorenzo Binago* (2002).
5. This situation lasted until the second half of the XVII century, when the building habits and the local skyline deeply changed because of the widespread use of the partially or entirely extradoxed dome, superimposed on a drum with windows.
6. Della Torre, Schofield (1994, 54–55). A previous interest for the model of the Pantheon in Milan can be found in the Scuole Canobiane, built after 1564, that were round and covered by a hemispherical dome near to that of the roman monument. Della Torre, Schofield (1994, 101, endnote 21).
7. On the dome of S. Sebastiano, see Rovetta (1990); D. Antonini (1998–99); A. Scotti, D. Antonini (2002).
8. Most of the documents regarding the structural discussion about S. Lorenzo dome (1589–90) can be found in the Biblioteca Ambrosiana, Milan, Raccolta Ferrari (BAM), Codex S 130 Sup.; for further references see Scotti (1999). For the documents concerning S. Alessandro, see Giustina (2002); *Lorenzo Binago* (2002).
9. BAM, S 130 Sup., CLXXXIV, M. Bassi.
10. BAM, S 130 Sup., CLXXV, M. Bassi.
11. BAM, S 130 Sup., CLXXV, M. Bassi.
12. Letter of L. Binago to the Deputati della Fabbrica del Duomo nuovo di Brescia, september 1615. See *Archivio* (1991, 410).
13. BAM, S 130 Sup., CLXXIV, M. Bassi. On this problem see Rocchi Coopmans de Yoldi (1991, 104–105).
14. BAM, S 130 Sup., CLXXVI, T. Rinaldi.
15. BAM, S 130 Sup., CLXXXIV, M. Bassi.
16. On the role played by experience in the understanding of arches and vaults behaviour, see Di Pasquale (1996).
17. BAM, S 130 Sup., CLXXXIV, M. Bassi.
18. L.B. Alberti (III, I) underlined that the strenght of masonry could be assured only by the absence of discontinuities.
19. BAM, S 130 Sup., CLXXXIV, M. Bassi.
20. BAM, S 130 Sup. CLXXIX, G. Mazenta. 1 braccio milanese = 0.595 m; 1 oncia = 0.049 m.
21. See Rovetta (1990); Antonini (1998–99); Scotti, Antonini (2002).

22. Arenghi, Tomasoni, Giustina (2002, to be published).
23. BAM, F 251 Inf., drawing n. 52. Scotti (1999, 130) observes that the drawing seems to be the one approved by archbishop Carlo Borromeo in 1577.
24. BAM, S 130 Sup., CLXXIX, G. Mazenta.
25. Arenghi, Tomasoni, Giustina (2002, to be published).
26. BAM, F 251 Inf., drawing n. 55, attribuited to Tolomeo Rinaldi. See Scotti (1999).
27. See for example the drawings: BAM, F 251 Inf., nn. 57–58; n. 56; n. 54; London, Victoria and Albert Museum, nn. 613, 614. See Rocchi Coopmans de Yoldi (1991); Scotti (1999).
28. Archivio Storico Civico di Milano, Raccolta Bianconi, IV, drawing n. 24.
29. BAM, S 130 Sup., CLXXXIV, M. Bassi.
30. Arenghi, Tomasoni, Giustina (2002, to be published).

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