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The Urban Draw of Pistoia: from historical cartography to metric design

The urban draw of a city represents the first element of our cultural heritage to be studied and preserved. Studying the historical cartography and the location of the various urban realities can be the beginning for a research that unites the metric data and the design of a territory and an urban landscape.

Looking from the top of the map of Pistoia it is possible to see its urban draw: an perfect scheme that only cities, whose origins date back to ancient times, have the privilege of possessing. In order to find an answer to the foundation of the hypothesis of a well defined design it was therefore necessary to place oneself on a different level from the usual one and observe the city from above. We know that most of the churches and convents that arose in these periods were born by the will of mendicant religious orders that increasingly spread thanks to the work and preaching of their founding friars who became saints

shortly after their death (San Francesco, San Domenico, Sant 'Agostino). Through the study, the survey and the analysis dealt with, it was possible to hypothesize that their location was not entirely random but that it was based on a precise urban planning reasoning and drawing. The rules of the draw create precise geometries, binding measures and Pythagorean triples, through the "fiorentina arm", the unit which was probably used at that time. The survey and study of the design of the city, through measurement and geometry, have allowed to understand the design method used by masters of the time. In that way, it has been possible to access to knowledge of data otherwise inaccessible and get the reading of the hidden measures of the project and invisible geometric genesis.

Keywords:

Urban draw; Fiorentina arm; Pythagorean triples; Geometric genesis;

INTRODUCTION

Living in a historic city and moving around in its urban space, living it in everyday life, gave rise to the launch of this research. An experience that over time has crossed the boundaries of habit, made of movements through the streets and alleys of the historic center, resulting in the curiosity to understand the conformation of a city that in its structure seems to hide calls and drawings not entrusted to chance, but rather born according to precise logic. Very often I happened to observe the plan of Pistoia and surprise myself in front of its urban design: an almost perfect scheme that only cities, whose origins date back to ancient times, have the privilege of possessing. From the Etruscans to the Romans, from the age of the Municipalities to the flourishing of the Renaissance, from the "Risorgimento" to the twentieth century; a twenty-five centuries long history that has seen the change of the entire urban territory allowing all the buildings to relate to the city and the citizens, but also to shape the city itself in relation to its buildings that rose over the centuries. In order to find an answer to the foundation of the hypothesis of a well-defined design it was therefore necessary to place oneself on a different level than the usual one and observe the city from above. Taking this perspective, it becomes easier to appreciate the original Roman street layout with *cardi* and *decumanus*, as is also the case in the neighboring Lucca and Florence. An imprint which was then superimposed on that of the Middle Ages with the changes that, in correspondence with the surrounding walls that followed one another over time, paved the way for the development of the still viable roads.

Sometimes we tend to think that the placement of a building, be it a church or a palace, can be dictated almost by chance or we simply do not ask ourselves why it is in that position. Specifically analyzing the relationship of the churches and convents of the thirteenth century in relation to the already built city, it is possible to find answers to these questions.

We know that most of the churches and convents

that arose in these periods were born by the will of the so-called "mendicant" religious orders, which increasingly spread thanks to the work and preaching of their founding friars who became saints shortly after their death (San Francesco, San Domenico, Sant'Agostino).

Through the analysis dealt with, it was possible to hypothesize that their location was not entirely random but that it was based on a precise urban planning reasoning and drawing. A fact that allows us to conclude that the architect of the time did not decide to prepare the building site in a space that remained simply empty, but that his work followed exact geometries in relation to pre-existing structures of great interest.

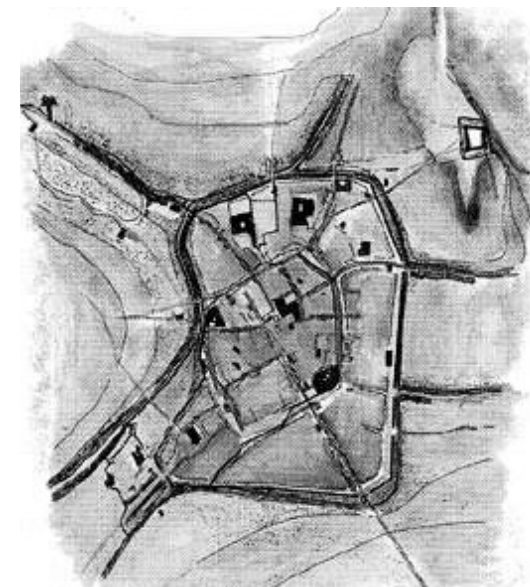
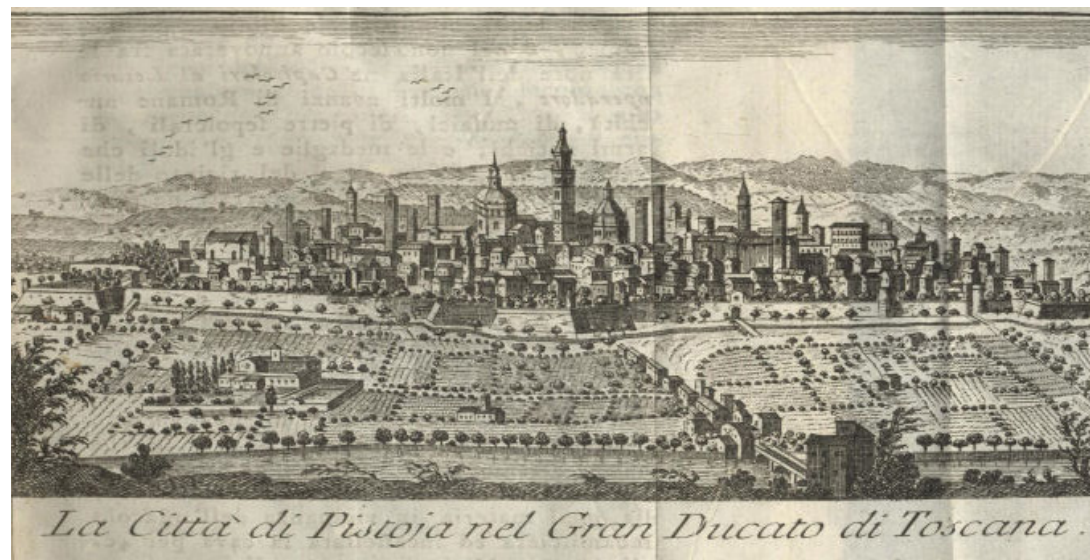


Fig. 1 - (down) View of Pistoia in 1740.

Fig. 2 - (to the side) Plan of the historical urban context of the city of Pistoia (at the time of the foundation of the Fortress of San Barnaba, 1334).



PISTOIA AND TWENTY-FIVE CENTURIES OF HISTORY

On the site where then Pistoia rose, twenty-five centuries ago, there was only a small plateau, formed by the material of deposit of two streams, the Ombrone and the Brana that descended from the heights of the mountains. That modest high ground is considered by today's historians as the starting point of the Etruscan foundation. Near this small hill, what is now the Piazza del Duomo, in the foundations and walls of medieval buildings were found three Etruscan funerary stones, dating from around the sixth century BC, the time of the full flowering of this people's civilization. Today, with good reliability, it can be said that the first inhabitants of the Pistoia area were also the Etruscans, albeit occasionally and in what subsequently the engineers of the Roman consular roads would have called a mansion, or a rest station. However, there is very little evidence of that time. In the second century BC the Romans, after having overcome the danger of the Punic wars, turned against the Ligurians, who had been allies of Carthage, as part of their expansion along the peninsula. According to their usual technique they built a consular road that carried soldiers and supplies to the place of the clash; they then extended the Via Cassia, which reached the height of Fiesole, involving the Pistoia area, and then headed

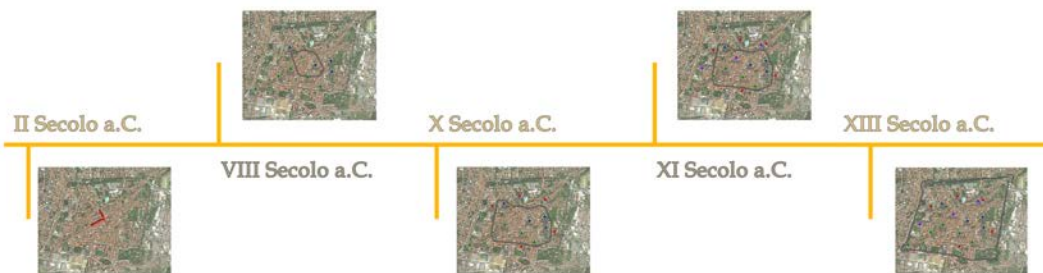
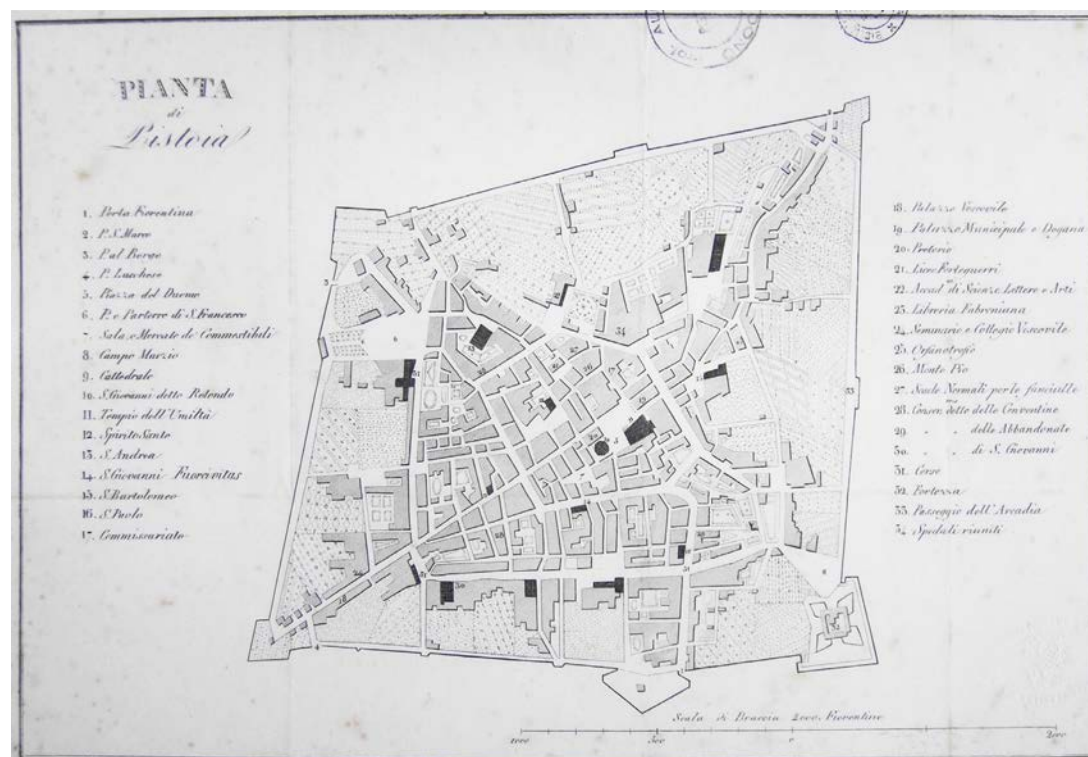


Fig. 3 - (up) Timeline of the succession of the city walls of Pistoia

Fig. 4 - (down left). Draw of the first walls of Pistoia

Fig. 5 - (down right) Pistoia's plant in "Fiorentina's arms"



towards the coast and rejoined with the Aurelia. The Via Cassia, therefore, constituted the east-west axis, i.e. the decumanus, of the *castrum*¹; the other axis, the maximum cardo in the south-north direction, crossed the first in the corner where a well was found. The tidy Roman camp, consisting of the squares resulting from the intersection of the two main lines², therefore arose in the space of the present Piazza del Duomo, expanding and becoming a fortified citadel, an oppidum, as was said in Latin.

The city has grown to reach a perimeter of almost 1200 meters, its scanning is clearly visible from above, especially in the shape reached in the early Middle Ages (VIII century), when the first city wall was built over the ancient fence. It is the one contained within the current streets Cavour, Buozzi, Curtatone and Montanara, Abbi Paziienza, delle Pape, Pacini and Palestro that characterize the heart of Pistoia.

On the tidy, perhaps prosperous, the citadel took over the fury of one of the first barbarian invasions that involved central Italy: that of the Ostrogoths led by Radagaiso.

The destruction caused by the hordes of Radagaiso, if they made the city survive, changed its shape and probably caused a period of decline. With the eighth century, the golden century of Pistoia as a "royal" city³ there was a notable rebirth: Pistoia, after all, for its territory bordering the Byzantines, had a strategic importance.

The walls were again raised, perhaps replacing the Roman ones destroyed since the Radagaiso era: and the walls remained more or less the same. At the cardinal points were the four gates: to the east the one dedicated to San Pietro, to the west the Lucca, to the north the Sant'Andrea gate, just outside the walls and near the church of the same name; to the south the Gaialdatica gate, at the end of the present San Leone square.

In the urban fabric still surrounded and defended by external aggressions from the walls of the eighth century, new fortifications rose, the territory was covered with *pievimi*⁴, around which villages were formed, along which the road network stretched and improved.

In the city, the second circle of walls was built, that quadrupled the urban surface, encompassing all the buildings that had arisen *extra moenia*. The new circle came to coincide only in a stretch, to the north, with the early medieval walls.

The thirteenth century, the "golden century" for Pistoia, however, saw the first contrasts explode with Florence. In 1251 Florence and Lucca, which will then be the traditional enemies, the most interested in containing Pistoia's development, faced Pistoia, which had made a league with Pisa and Siena, that is with other cities worried about a possible Florentine hegemony.

The peace was concluded in 1254: but what had happened, originated from the contrast between Guelphs and Ghibellines that then would have bloodied all Tuscany, was a simple taste of what had yet to happen (Fig.3).

It is from this point that the reconstruction object of the study begins, which led to the hypothesis of a targeted and non-random arrangement of some religious buildings of the thirteenth century.

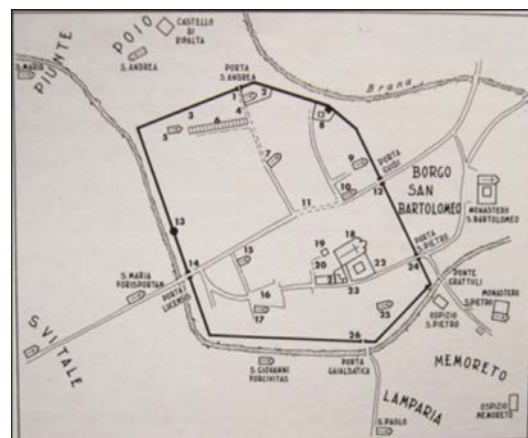
THE MENDICANT ORDERS AND THEIR SETTLEMENTS

Although there is no historical work on the mendicant orders as mentioned by André Vauchez in literature⁵, the streets and squares of our territory have, in the urban landscape, the imprint of the presence of the "friars": convents, churches, oratories that testify to the impact of their message on the population from the 13th century to the Renaissance. In France, the historian Jacques Le Goff, at the end of the Seventies, studied the relationship between the presence of beggars in a medieval agglomeration and its urban character, affirming that this was very narrow and that the number of convents of beggars present in a city, the more its degree of urbanization was high and its importance was relevant too. Even in Italy, in recent decades many authors have devoted themselves to research on mendicant orders, confirming how important their urban anchorage was, occupying strategic positions corresponding to their hegemonic position on the religious level⁶. The mendicant orders that have passed into history and whose existence is proved, are the Dominicans, the Franciscans, Servants of Mary and Augustinians, although often the first two are the only ones remembered as they were the main ones.

Founder of the Dominicans was Domenico di Guzmàn, born in 1170 and belongs to a noble family of old Castile, who very soon was directed to the clerical state and his ecclesiastical career was very brilliant. He founded the Order of Friars Preachers in 1216, which was recognized in 1217 at "Ordo Praedicatorum" because of the specific nature of their mission.

In the heart of Italy, at the end of 1181, the son of a rich merchant from Assisi was born, who, having made his fortune in France with the trade in textiles, decided to call his son Francesco in honor of the nation that had given him so much luck. Francesco Giovanni di Pietro Bernardone will then be known to all as San Francesco, a man who has marked the history of the West on a religious and cultural level so much, that even today his action

Fig.6: Hypothetical reconstruction of the situation of Pistoia in 1100



is a source of fascination, admiration and devotion. After his death, his belief spread like wildfire and soon every town had a Franciscan convent, thanks also to the support of the Papacy sure to be able to count on this new strength, together with the order of the Friars Preachers created in the same age from San Domenico, in the fight against heresy.

Shortly after the canonization of San Francesco and San Dmenico, the Order of the Servants of Mary was born, also called Serviti, a mendicant order of the Catholic Church. It was founded in Florence, probably in 1233, by a group of seven people, later known as the seven founding saints. Last of the Mendicant Orders as foundation date is that of the Augustinians. In 1243 Pope Innocent IV invited some hermit communities of Tuscia⁷ to meet under the Rule of Sant'Agostino. Soon the communities of the order spread throughout Italy and even abroad.

The churches of the mendicant orders crossed three different periods in which they changed their constructions; in an early period ending around 1240, the friars were content with very modest buildings to manifest their special regime of poverty; in the second, hypothesized until around 1265, they created a type of church according to their particular ministry; during the third they developed several elements following the assertion of their prominent position in civil society and in the church. The churches built in the first period, very modest, reflected the precise ideal of poverty: the very name of the beggars, in fact, presupposes not only the poverty of the individual religious, but also of the conventual communities, which do not live off fixed income, but of the offerings of the faithful who benefit in exchange for their apostolic ministry.

ARCHITECTURE AND UNITS OF MEASUREMENT

In order to address a study about the relationship between religious settlements and defined measurement systems, therefore, a reflection is needed on what were the systems of measurement before the advent of today's metric system.

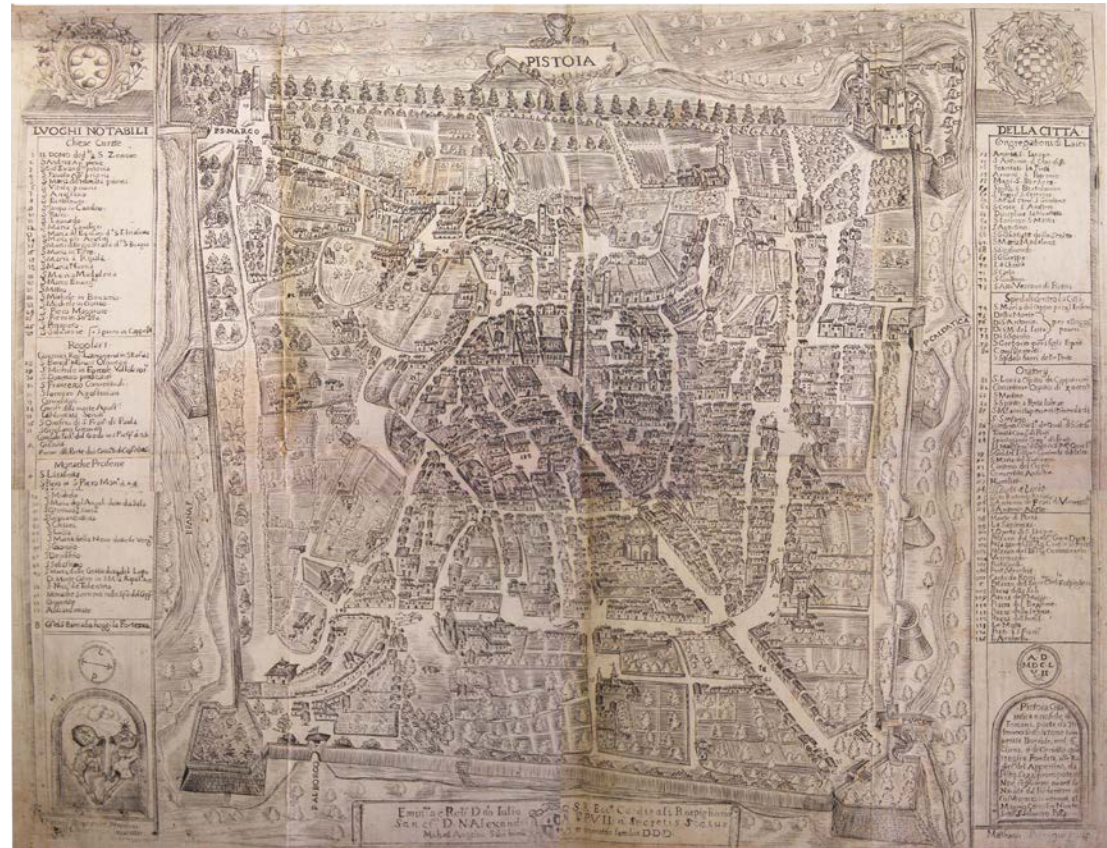


Fig.7: Francesco Leoncini, The reconstruction of the map of Pistoia at the date of 1657

If today, in fact, it is sufficient to move a comma or add a zero to obtain a variation of the unit of measurement, it is only thanks to the fact that the base of our system is ten, making it so simple and functional in all its uses.

In ancient times the numbers were not considered only for their intrinsic meaning but were often connected to the religious sphere or to events that occurred in very distant times, but very rooted in the mentality of the individuals of the time. In an-

cient systems, in fact, in addition to the numeral base of 10, we find also the 4 or the 6 with their respective multiples of which today we only drag ourselves some legacy (just think of the fact that our calendar has 12 months or that we still use dozens for to count certain foods)⁸. A metric system consists of a sample length, from which others derive by division or by multiplication. At the time, however, there was no single multiplier or divider but different in relation to the base that

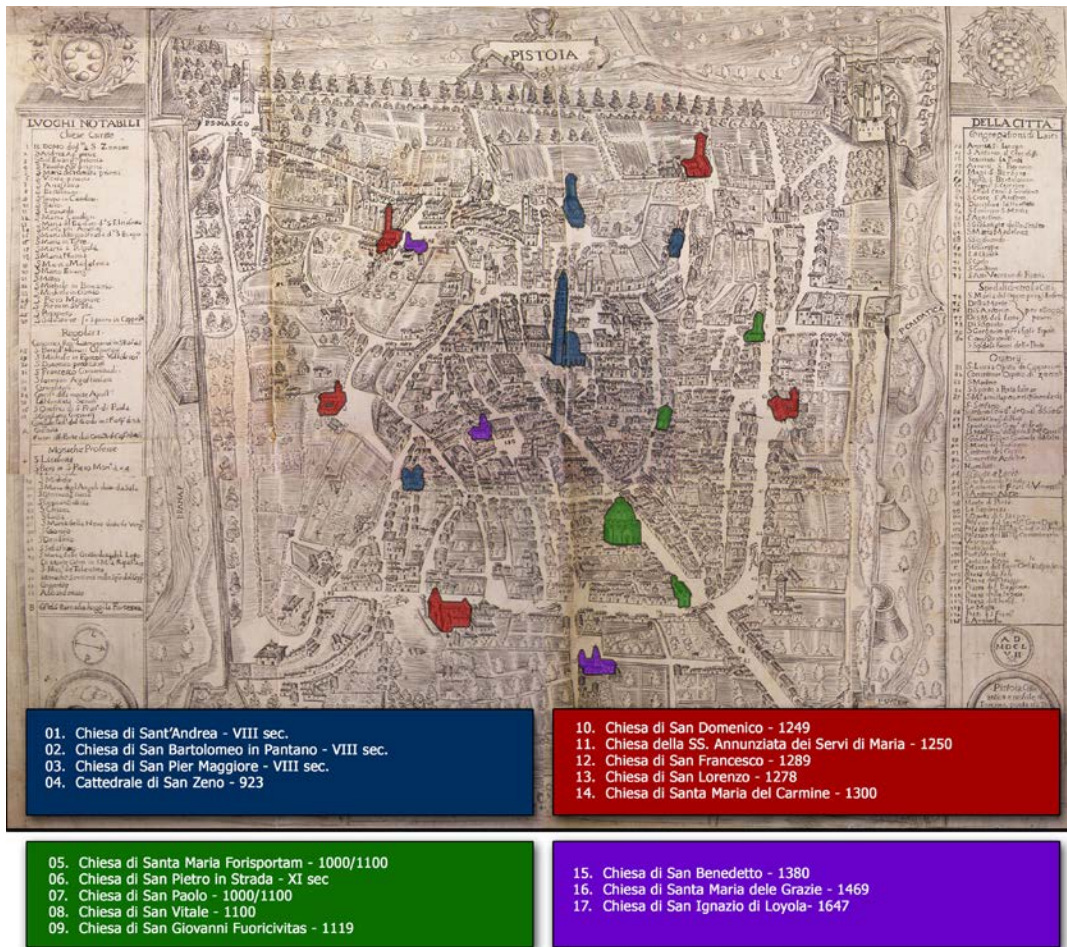


Fig. 8: Graphic identification of the main parish churches and churches on the basis of the 1657 cartography of Leoncini

was used. Consequently, depending on the unit of measurement considered, the values for expressing a hypothetical length could be very different from each other, precisely in terms of numbers to express it.

In thirteenth-century Florence, architects could have a very rational and efficient metric structure that soon allowed them to export it even outside the city limits. The reference module of this system was the "braccio da panno", literally "cloth

arm", (equal to 58.36 cm) with its sub-multiples: each arm was divided into 20 "soldi" ("coins") of 12 denari each, or 12 "ounces" of 20 denari; the multiples towards the large were instead "canna agrimensoria", [5 "cloth arms"] and the "canna mercantile" composed of 4 "cloth arms". It is thought that the Florentine "arm" was in relation with the ancient Roman foot, and that it could derive from Syrian measures bringing an enormous advantage to trade (Fig.9).

From the works of Leonardo Pisano called Fibonacci (Liber Abbaci; Practica Geometriae) we learn how in ancient Florence there was the intention of some to learn and teach how applying science, and specifically mathematics, to real life and everyday life, they could derive enormous benefits. This led to a great spread of the schools of Abaco and with them a great economic growth of the city. This development intersected intimately with the work of the architect of the time who owes so much to mathematics and geometry to develop his ideas first in design and then for the search for the best solution. Problems related to trade and sale had been simplified with the introduction of units of measurement that clearly defined the surface dividing it into precise modules. The Fibonacci reports to us, drawing inspiration from the description of the practice carried out for the sale of the fields, which was the system used. The fundamental unit was the "square perch", whose side is equal to a "linear pole", equal to 6 linear feet. The square foot is a rectangle (and not a square with the side of a foot that took the name square "denaro" instead) whose base is equal to 6 feet and the height of 1 foot. It can be deduced that it measures 1/6 of a square perch. The basis of this measurement system was the 6, a choice probably linked to ancient customs in land surveying. In the upper modules instead, just in the use of the sale of the fields, we find it "staioro" that is the unit of measurement of the area equivalent to the surface of a rectangle with the base of 33 arms and the height of 10 perches. From this it follows that the surface of the staioro is equal to 66 square perches, or 1650 square arms. In Florence, architecture fully embraced this system that perfectly met

the needs of the time. It is therefore credible that even cities under Florentine power, such as Pistoia, took on such units as systems of measurement.

THE MENDICANT CHURCHES AND THE DESIGN OF THE CITY

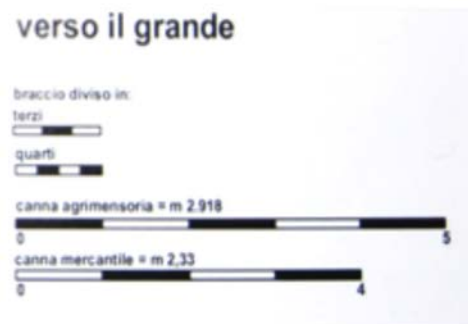
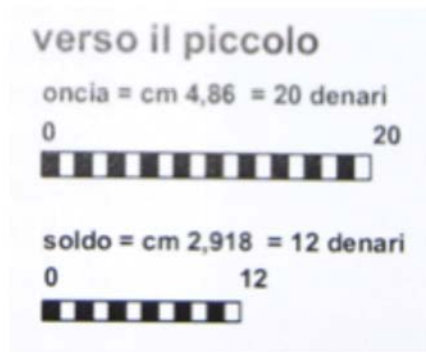
The second circle of walls, encompassing external buildings and expanding the urban fabric, gave “breath” to the city that grew not only in extension, but also in quality: the roads that formed along the former first wall, taking advantage of the space created by the filled ditches, they were “large and airy”. Equally important were the highways of service to the four main gates (Porta S. Andrea, Porta Lucchese, Porta Gaialdatica and Porta S. Leonardo in Pescina).

If we look at the 1657 cartography by Francesco Leoncini (fig.7), or even better the Leopoldine cadastral map (fig.15) of the city of Pistoia of 1875 it is logical to think that this could have been the pre-existing situation, albeit with a free graphic interpretation by the author. It is possible, however, to recognize the footprints left by the succession of masonry buildings and it is possible to recognize the main parish churches built around them. (Fig.8) To better explain the method followed to obtain the hypotheses on a possible urban design of the city it is necessary to take another step back to when it was still presenting the first city wall (Fig. 6). We must refer to the current church of the Madonna dell’Umiltà (Fig.10), but not in the guise in which we know it now but in what it was originally. To the west, where the “Porta Lucensis” opened⁹, a church was built dedicated to the Vir-

gin Mother outside the strip of land called pomeium¹⁰, about one hundred and fifty meters wide. In the early Middle Ages the cult of Mary reflected all the content of Christianity, and therefore a church built on the margins of the pomeorium dedicated to the Virgin Mother constituted the essential cornerstone of that mystical belt of churches and monasteries which for the mentality of the time represented a bulwark against evil.

The small church, in fact, took the name of “Santa Maria Forisportam”, due to its location along the extra-urban road. It probably consisted of a rectangular hall with an apse facing east and a west facade overlooking a small churchyard. It is not to be excluded that there was an additional side door next to the nave that overlooked the Lucchese street (the present Via della Madonna). The Church represented a pivotal point of the city as it was the destination of Marian pilgrimages. Precisely because of its importance it was possible to deduce that the Church represented a fundamental point not only for the pilgrims who came there, but also for the buildings built in the following centuries. In fact, around the new route designed by the second city walls in the following centuries religious buildings have arisen belonging to the convents of the four urban religious orders such as the Franciscans, Dominicans, Augustinians and Servants of Mary. Their distribution in the urban fabric shows a strong relationship between the first two and the ancient Santa Maria. This intuition has led to imagining an urban design that follows non-random directions. The Pieve di Santa Maria would represent the center of an orthogonal line to the street facing the Church (the ancient Via Cassia), which would connect the two convents and the Churches of San Francesco and San Domenico. If we imagine to draw a line connecting the Church of S.Francesco (Fig.11) to the west of the city and the Church of San Domenico (Fig.12) placed instead to the south, it is evident that the middle point of this line it stands on the current Church of the Madonna dell’Umiltà and therefore the ancient parish church of Santa Maria. Moreover, the distance of the two convents from it turns out to be about 296 meters comparable with 500

Fig. 9: The Florentine measurement units in Gothic times



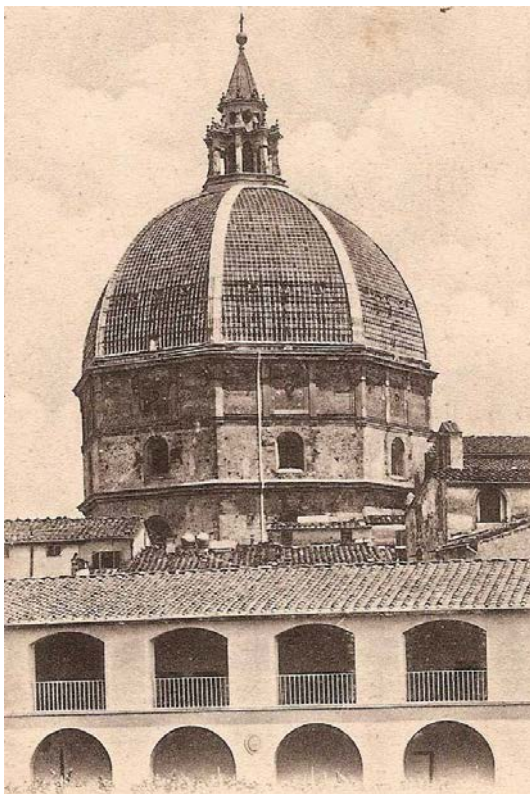


Fig. 10: (left) The Church of the Madonna of humility

Fig. 11: (up) The Church of San Francesco

Florentine arms (unit of measurement probably used in that period). The distance between the two convents is in fact around 1000 Florentine arms. The orthogonality of this imaginary line, which connects the two convents, with the ancient Via Cassia on which the little church of Santa Maria faced, makes us think of a precise urban design. The imaginary line that connected the two convents rests not only on the small parish but in particular on the area where the bell tower was supposed to rise. This element would represent the “directional tower” on which to orientate the buildings. Furthermore, this thesis is further corroborated by another similar aspect: an orthogo-

nal line to the one just described, at the distance of about 1000 Florentine arms, ends on the area where the convent of San Lorenzo was built (Fig.14) belonging to the order of the Augustinians, and where the Porta S. Leonardo in Pescina was present. In this way exactly two right-angled triangles would be obtained with the ancient Church of Santa Maria Forisportam as vertices of the right angle. Similarly two other right-angled triangles are created, with the proportion between catheti and hypotenuse of 3-4-5, with the ancient church of San Vitale attested by 1080, and the churches of Santa Maria, San Francesco and San Domenico. Along the route of the old Via Cassia, which led

to Lucca, stood numerous churches that marked the entrance to the city. At the exact opposite of the area where the complex of San Lorenzo will be built, founded by the Augustinians, at a distance of a thousand Florentine arms from the now pivotal point, Santa Maria, the church of S. Pietro in Strada was built, documented since the XI century (first suburban parish but then included in the last circle of walls erected after the destructions perpetrated in 1306), a church that has now completely disappeared and been replaced by residential buildings. Only a few drawings remain to us, as evidence of his presence (Fig. 13). This hypothesis, however, does not appear to be the only one: apart

from the most elementary case of the relationship between two beggar complexes and a pre-existing building of particular interest, to be master in this reconstruction, is the "triangular model" that links Dominicans, Augustinians and Franciscans. In doing so, however, a discriminating factor is already inherent because it concerns only three of the mendicant orders usually found in the great Tuscan cities. In fact, Carmelites and Servants of Mary are generally present, so in these cases a hypothetical rule of organization of urban space should be experimented with reference to a pentagonal or in some cases quadrangular system. It was possible to give a real foundation to this hypothesis, simply by building a polygon that connected the facades of the five buildings (or of the four if we do not consider at first the Carmelites settled in a later period) of the five orders present in Pistoia. Calculating its center of gravity, it became clear that it falls exactly in the area occupied by Piazza del Duomo (Fig. 17).

The presence of the Mendicants has certainly affected the urban structure; apart from the large squares that opened up in front of their churches, suitable for hosting large faithful competitions, many streets were built to facilitate access to convents. Of these urbanistic interventions often remains a documentary trace, as in Pistoia, when at the end of the thirteenth century it was decided to enlarge the road that led to the new church of San Francesco, or to build the New Way of the Friars Preachers which led to San Domenico. The distribution of the Pistoia convents would therefore reflect the relationship of the Mendicants with the urban society, to which they turned and from which they received those subsistence that the profession of poverty made indispensable. The position of the convents with respect to the city's administrative center, Piazza del Duomo, fully reflects the principles of equidistance with buildings of particular public significance; just remember that the Piazza del Duomo in Pistoia embodies secular and religious power, thanks to the presence of the Municipality, the cathedral and the courthouse.



Fig. 12 (up): The Church of San Domenico

Fig. 13 (down left): Church of San Pietro in Strada, 11th century (drawing of 1614) built along the route of the ancient Via Cassia

Fig. 14 (down right): The Church of San Lorenzo



FINAL CONCLUSIONS

«Architecture, the discipline of building, chooses, directs and judges the practical and theoretical contributions of many other sciences and arts. (...) the true architect must possess intellectual talents and aptitude for learning ... Therefore be him competent in the field of letters and above all of history, skilled in drawing and good mathematician»¹¹

The purpose of this work was, from the beginning, that of giving a simple but at the same time complete interpretation to learn to read the architecture of a city and its buildings.

Read the city as if it were a definite design, according to a geometric symbolism, so that it could represent an essential cornerstone for the urbanization of the whole city. A way of interpreting the vocabulary of buildings through the measurement of the city plan.

It was possible to demonstrate that the rules of drawing build geometries that link Pythagorean measurements and triplets. It is through the use of the Florentine arm, a unit of measurement of time, that it was possible to hypothesize the geometry of the city. The survey and the study of the design of the city have allowed, through the measure and the geometry to understand the way of designing the masters of the time, accessing the knowledge of data otherwise inaccessible and obtaining the reading of the hidden measures of the project and geometric genesis not visible.

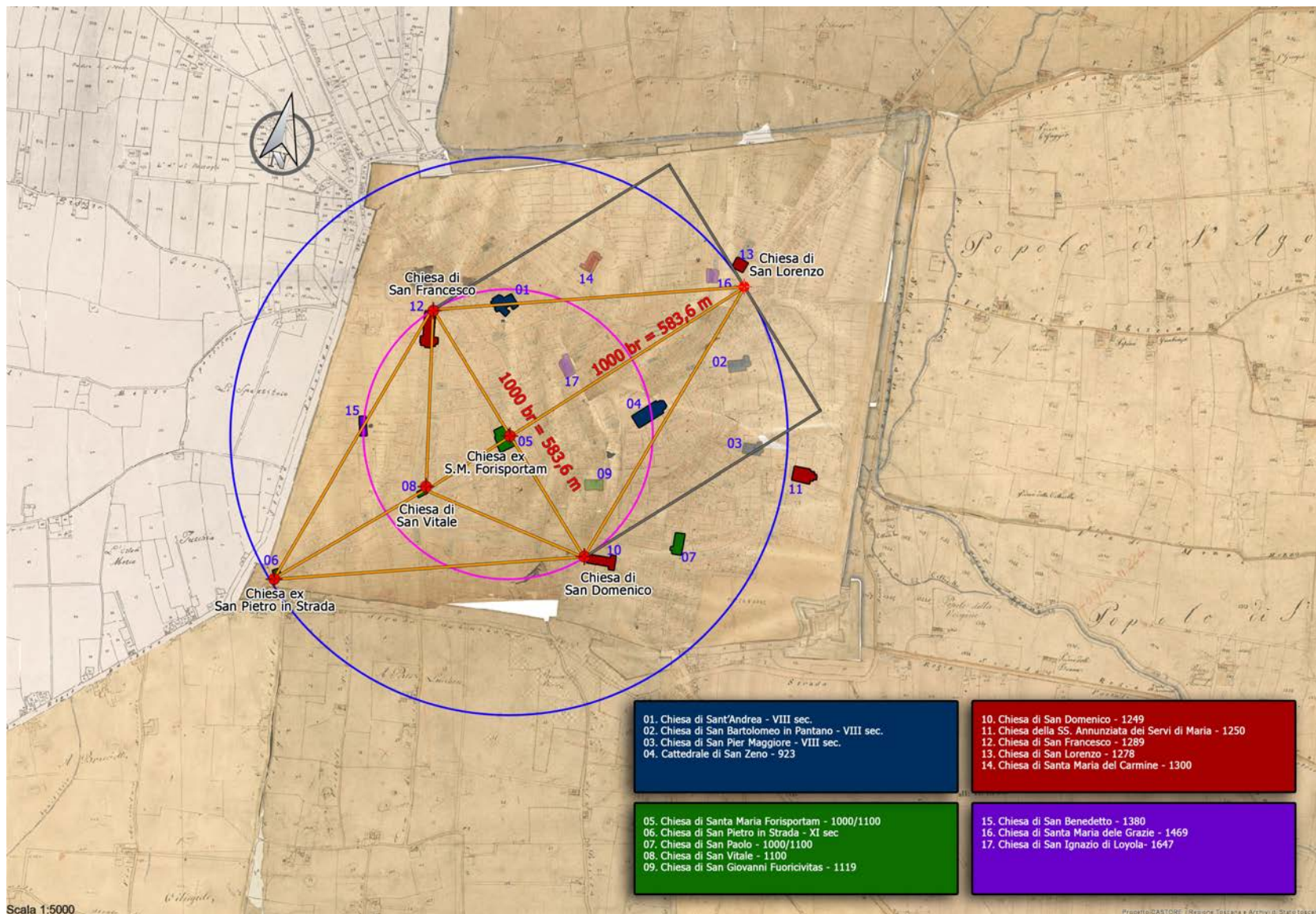


Fig. 15 (up): Leopoldine cadastral map of the city of Pistoia of 1875

Fig. 16 (down): View of Pistoia

Fig. 17 (next page): Reconstruction of the urban design of Pistoia on the basis of the hypotheses formulated in relation to the positioning of some ecclesiastical buildings of the city





- 01. Chiesa di Sant'Andrea - VIII sec.
- 02. Chiesa di San Bartolomeo in Pantano - VIII sec.
- 03. Chiesa di San Pier Maggiore - VIII sec.
- 04. Cattedrale di San Zeno - 923

- 10. Chiesa di San Domenico - 1249
- 11. Chiesa della SS. Annunziata dei Servi di Maria - 1250
- 12. Chiesa di San Francesco - 1289
- 13. Chiesa di San Lorenzo - 1278
- 14. Chiesa di Santa Maria del Carmine - 1300

- 05. Chiesa di Santa Maria Forisportam - 1000/1100
- 06. Chiesa di San Pietro in Strada - XI sec
- 07. Chiesa di San Paolo - 1000/1100
- 08. Chiesa di San Vitale - 1100
- 09. Chiesa di San Giovanni Fuorcivitas - 1119

- 15. Chiesa di San Benedetto - 1380
- 16. Chiesa di Santa Maria delle Grazie - 1469
- 17. Chiesa di San Ignazio di Loyola - 1647

NOTE

[1] Roman camp set up on that relief of ancient Etruscan settlement.

[2] Squares that then gave rise to neighborhoods and names at the gates of the city.

[3] subject to the direct power of the Lombard ruler

[4] churches authorized for the sacrament of baptism

[5] André Vauchez , Mendicant Orders and Italian Society XIII-XV century, pag 9

[6] Guidoni et al. Architecture and urban planning of mendicant orders, history of the city

[7] extensive territory that included today's Tuscany, upper Lazio and the western part of Umbria

[8] Maria Teresa Bartoli, "Musso e non quadro". The strange figure of Palazzo Vecchio from its relief, pages 22 and ff, note 7

[9] Still remembered in the current toponymy as "Porta Vecchia"

[10] The pomerio, or in the Latin language pomerium, was the sacred border of the city of Rome.

[11] Marco Vitruvio Pollione, De Architectura, 25 BC

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