

## GEOMATIC FOR CONSERVATION: “THE SHADOW AND THE REALITY” READING THE SPERIMENTAL AND THEORETIC EFFORTS OF WORLDWIDE RECOGNIZED GENIUS: LEON BATTISTA ALBERTI

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“Pertanto gli architetti i quali badarono soltanto alla pratica manuale senza curare gli studi non arrivarono a conseguire un’ autorità proporzionata alle loro fatiche; quelli invece che ebbero fiducia solo nei ragionamenti e nelle lettere appaiono aver cercato L’OMBRA NON LA COSA. Al contrario, quelli che impararono bene l’una e l’altra cosa, forniti di tutte le armi, più presto raggiunsero il loro proposito con autorità”.

VITRUVIO, De Architectura (1)

### 1. THE MISTAKE OF PHYTHEOS

I believe that the most appropriate definition of Architecture, after more than two millennium, remains that given by Vitruvio (*“Architecti est scientia pluribus disciplinis et variis eruditionibus ornata: ea nascitur ex FABRICA et RATIOCINATIONE”*).

Architecture is the result of the combination of manual and mind skills and is the union of practice and theoretical thinking. Vitruvio is very clear and lapidary on this: *“sine litteris”* there is no *“auctoritas”*, notably the credibility, without the manual skill of the *“fabrica”* (*“fabrica”*), there is only Appearance (*“umbra”*) and not the reality (*“cosa”*). Vitruvio referred to an example coming from the Antiquity (*“de veteribus architecti”*): Phytheos built the temple of Athena in Priene and considered that the Architect, among all arts and disciplines, has to be able to do more than other specialists in his field of competencies, fact that in reality is not happening (*“id autem re no expeditur”*). Alberti commented stating that Phytheos was wrong in this assertion, because *“each art is composed by two parts: the practice and the conceptual support (‘ex duabus rebus singulas artes esse compositas. Ex OPERE et eius RATIOCINATIONE’)*. That means, that for Vitruvio, the Architect cannot be perfectly acquainted with all disciplines; for those who are particularly clever, and able to go in deep in geometry, astronomy, music and other disciplines, they will be considered excellent architects and he added mentioning the cases of Aristarco, Filolao and Archita, Eratostene and Archimede, but this persons are very rare (*“hi autem inveniuntur raro”*).

### 2. THE INDISPENSABLE DISCIPLINES FOR THE ARCHITECT

One of these rare persons (*“rari vires”*), is certainly Alberti. He went back to the *lectio* of Vitruvius, clarifying so many obscure meanings and integrating it with the information coming from the classic sources, available at that time in the Italian courts where he went (Padua, Venice, Ferrara, Florence), and of course at the Vatican court, where he was working as Apostolic *“Abbreviatore”* since the Thirties. While in Rome, in 1450 he worked on the preparation of the ten volumes of his treatise on Architecture. This systematic work was dedicated to and prepared for the Pope Niccolò V, who had studied with him in Padua.

In the introduction to the *De Architectura* (2), elaborated on the structural model adopted already by Vitruvius, the typology and number of disciplines which the architect needs to be acquainted with, to appropriately perform his work increase.

Alberti, who had a large and clear vision on the problematic related to sciences and techniques, anticipating in this desire to known and explore, the *“curiositas”* of Leonardo, gave importance and practised with particular vocation and systematic efforts, analytic and sperimental disciplines, so that we can consider him today as the father of the topographic science, which today, since few years we are conventionally naming as *“geomatic”*, a neologism defined in Canada (1990), at the University of Laval, with the decisive input offered to the architectonic assessment and monitoring by the computerized data processing as well as by the digital images analysis and interpretation. The traditional etymology of this term (which in reality put together the term *geo=ground*, the suffix *matic*, such as *grammatic*, *mathematic*, and so on) has been refused, assuming the same process already adopted for the term *“informatic”*, to recall the new strong alliance between geographical positioning survey and informatic (3).

This brief contribution intends to highlight the relevant and forgotten role of Alberti in the history of urban and architectonic survey, for whom was lacking only the accessibility to modern tools of informatics and the use of computer (4).

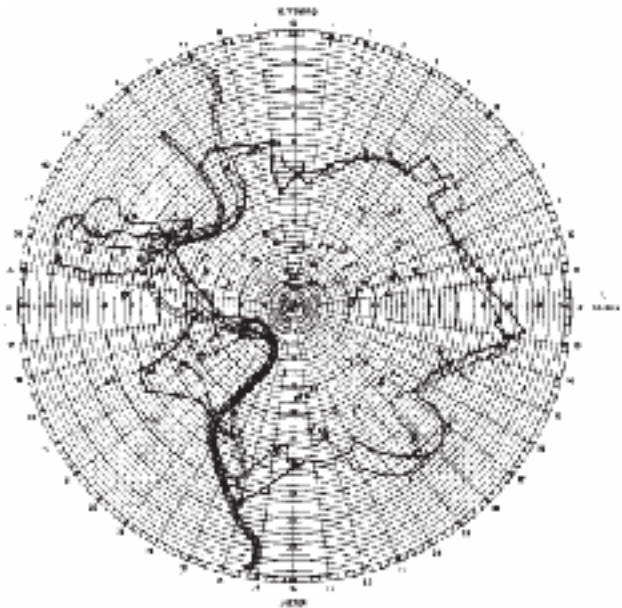


Figure 1. Rome, hypotesis of city map, based on Alberti’s *“Descriptio Urbis Romae”*

### 3. THE “DESCRIPTIO URBIS ROMAE”

The “*Descriptio Urbis Romae*” (1440-1447) is the result of this topographic mapping experience of Alberti. After the partial maps prepared by Giovanni Dondi dell’Orologio (1375), Ciriaco, Donatello and Brunelleschi, Alberti is the first who could produce for the Pope a complete map of the town of Rome; the survey and the survey was undertaken thanks to mathematic coordinates and trigonometric methods, and using instruments of his invention (the “*horizon*”). Bernardo Rucellai wrote that Alberti could report correct place and measures of the town wall of Roma and that he could meticulously calculate them with mathematic instruments (“Del sito e della misura delle muraglie di Roma ragionò molto rettamente Battista

Alberti, che con somma diligenza la calcolò mediante strumenti matematici”). This careful measurement method is also reported by the same Alberti in Chapter 7 of the tenth book of the *De Re Aedificatoria*: “ci serviamo con ottimi risultati dell’ausilio del cerchio per la descrizione di città e regioni e per redigere la pianta”. Alberti directly wrote to have surveyed and measured carefully what could be measured using mathematic tools and that his method aimed at producing a method applicable for everyone to obtain the map of the urban area of Roma at different scale (“con diligenza scrupolosa le misure che riuscii a stabilire con strumenti matematici; ed immaginai un modo, mediante il quale chiunque, sebbene dotato di mediocre ingegno, può in bella e comoda maniera rilevare la pianta di Roma in qualsivoglia proporzione”).



Figure 2. A sheet from Alberti’s “*Descriptio Urbis Romae*”

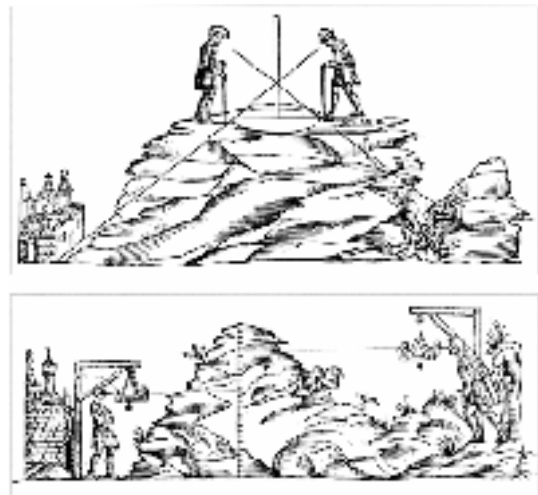


Figure 3. Measuring techniques published on Cosimo Bartoli’s edition of “*De Re Aedificatoria*”

### 4. THE “LUDI RERUM MATEMATICARUM”

It is in particular in the treatises written in particular occasion for the princes of the Italian courts, where Alberti gave his sperimental and ontological contribution. As example, among these, the *Ludi Matematici*, dedicated to Meliaduso d’Este, prince of Ferrara, in the same years when he was abbeist of Pomposa, Alberti was completing the *De Re Aedificatoria*. Rules of fields and lots measurement, and therefore more general measurement’ problems, should be at that time among the major topics of discussion by scientists at the d’Este court. Alberti was conscious that this was not an easy task (“mi convien rammentare - he wrote - che queste sono materie molto sottili e male si possono trattare in modo si piano che non convenga stare attento a riconoscerle”). Showing a level obtained by a disc calibrated with plummet (named by him

“*equilibria*”), he was inspired by ancient codex. Among the ancients, he clearly referred and mentioned Columella and Savosarda, while among the recent architects, he referred to Leonardo pisano: he explained several new tools such as the odometer, the igrometer (“riscontrai come la spugna s’impregna dell’umidità dell’aria, quindi formai una bilanciaper pesare la gravezza dei venti, dell’aria, della siccità”), the “bolide” (for fields measurement), and several types of portable watches. It is known, that Alberti in his *Commentari delle cose matematiche*, unfortunately not conserved to us, he offered usefull “preetti sui pesi e sulla misura delle superfici e de’ corpi e che i Greci appellano podismati ed ambadi” and that in his treatise, also not conserved till today, “sui movimenti del peso” he could solve important mechanic problems of the lever, of pulley, of screw and of inclined plane



Figure 4. Height measuring techniques published on “*De Re Aedificatoria*”

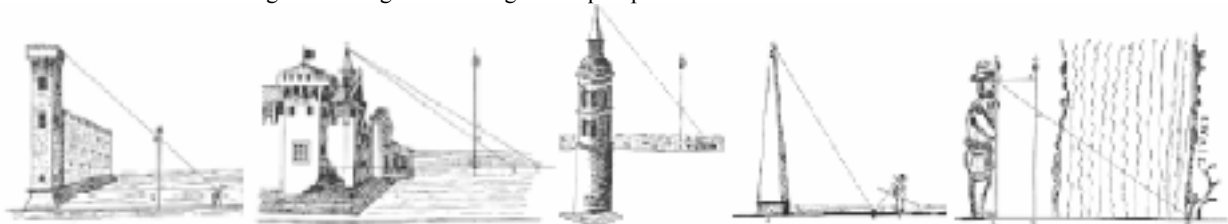


Figure 5. Height and distance measuring techniques published on “*Ludi Matematici*”



Figure 6. Bedolina map (Valcamonica) drawn on stone around 1400 a.C.

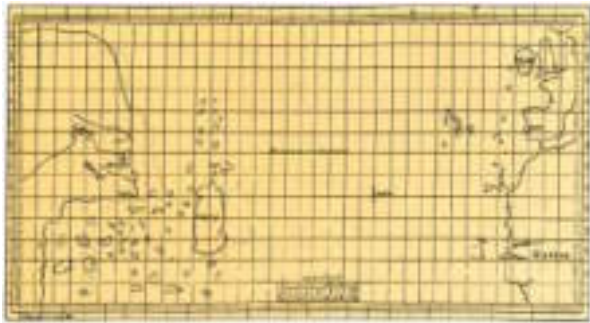


Figure 7. Hypothesis of Toscanelli's world map



Figure 8. Piri Reis' geographical map made in 1513

##### 5. ALBERTI "CONSERVATOR URBIS" AND RESTORER

Alberti is not only the ancestor of the survey and measuring science (as the "*Ludi Matematici*" demonstrations point out: "if

you are on the corner of a square and you want, -he wrote- to measure the height of a tower, but you do not know anything except the distance between you and the tower" -"se volete, col sol vedere, sendo in capo a una piazza, misurare quanto sia alta quella torre..."; "if you want to measure the height of a tower and you can only go near its base..." -"misurate in questo modo l'altezza di una torre della quale niuna parte a voi sarà nota, ma ben potete andare sino al pié della torre..."; "if you want to measure the height of a tower, but you can not go near it..." -"se vorrete misurare l'altezza di una torre dove non vi potete apprestarvi..."; "if you want to measure the height of a tower, but you can see only the top of it..." -"se vedrete di una torre solo la cima e nulla altra sua parte, e volete sapere quanto sia alta..."; also "you can measure the depth of a well only with your eyes..." -"misurate quanto sia profondo cavato fino all'acqua un pozzo solo col vedere...").

Alberti is not only an analyst, he is also the first theoretical interested (and worried) in ancient monuments. Mentioned "*conservator urbis Romae*" by Niccolò V, Alberti was motivated to the direct survey of the ancient classic constructions, he is the first treatise writer who dedicated his thought to monument restoration. In fact, in the last, tenth book of his treatise "*De Re Aedificatoria*" he points out several buildings consolidation experiences planned for the great roman monuments, particularly for the Vatican Basilica. "The building -Alberti wrote- it is a sort of body and, as the other bodies, consists of DRAWING and MATERIA, the first one produced by the mind, the other one by the nature". Investigating the errors made by the architect on his construction site, he convinced himself on "the way to correct them with the restoration". Finally, he become a determined defender of a particular kind of work nowadays defined "programmed maintenance", invoking the creation and strengthen of groups of safeguard experts: "the ancestors habit of establish, with public money, groups of experts in public buildings care and safeguard is certainly recommendable" (he wrote "*familias ex publico constituebant ut opera curarent publica atque tuerentur*"). This is an extremely, contemporary call that the good modern conservator can not elude.

##### 6. SURVEY EULOGY IN VIEW OF THE CONSERVATION PRACTICE AND THE INFINITE IDENTITY PARODOX.

A fundamental observation on the survey concerns its reference to a precise time: each observed object and/or building does not present an invariable character, implying that a unique survey is sufficient to know it in all its part. The attributes "exhaustive, thorough" are often used ingenuously by the authors of surveys to define the results of their surveys, but it is clear that the object, or the monument to be surveyed, changes according to the point of view of the observer and the objectives of the analysis that the observer want to achieve. However, this "photogram", even if isolate, can not recall to the entire film. Every image fixed on paper (or on the screen of the computer) by the diligent surveyor expresses the transitional status of the observed object, taken at the punctual time of that record (as the ancient said *ad horas*), and therefore it constitutes a unique document in a system permanently in evolution, evoking and recalling the other pieces, all indispensable, of the same channel in evolution. So, which results the identity of the surveyed monument or object? Is it the summation of all its transitional status? The temporary identity of each photogram contributes to compose the identity of the monument or the object, which remains open to the future, but which cannot take its place. The careful observer and analyser shall take into account the so-

called “paradox of the infinite identity”, announced by Deleuze. Its epistemological importance consists in the fact that it is “first of all what destroys the common sense as a unique sense, but also what destroys the common sense as (improbable) assignment of fixed identities” (5).

If we privilege in the analysis and in the quantitative and qualitative restitution of a material document the open process which affects throughout the time, then we will discover a new potential role for the photogrammetric restitution, as first aiding companion for the good conservator. In other words, the precious and virtuos companion who helps the passage from the knowledge plan, from the appearance to the essence, from the external, surface data coding, to the meaningful building anatomy and to the buildings material components. This is also a dated witness of the next passage from material survey to non-destructive diagnostic and to the conservation plan elaboration.

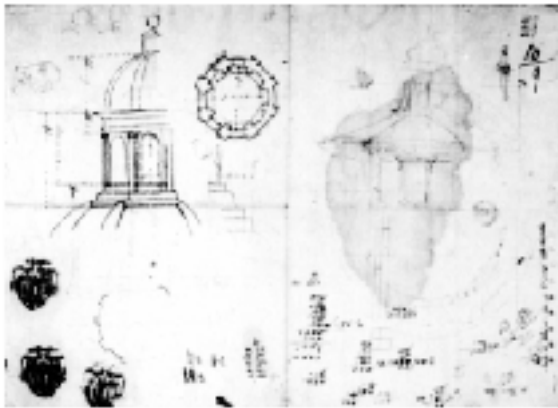


Figure 9. Camillo Morigia, sketches for a cupola, XVIII century

The path which led from the survey carried out by Alberti with the means available at that time, according to the information transmitted by his commentators (such as Cosimo Bartoli and so on), to the drawings prepared by Ruskin in Venice on the state of consistency of a building and the documentation of its deformations, described with a great attention and deep into details, *hic et nunc* (including the pathologic factors and the presence of polluting or accidental elements, such as grass, etc.), included by Ruskin as images in his *Seven Lamps of Architecture* (1849).

Today we start to have some references in some significant examples of survey specifications (6) and for conservation works (7), with their relative technical cards.



Figure 10. [Left] Confectioner's note used as bookmark in the Keplero's treatise (Morigia library). [Right] Camillo Morigia, mathematical notes.

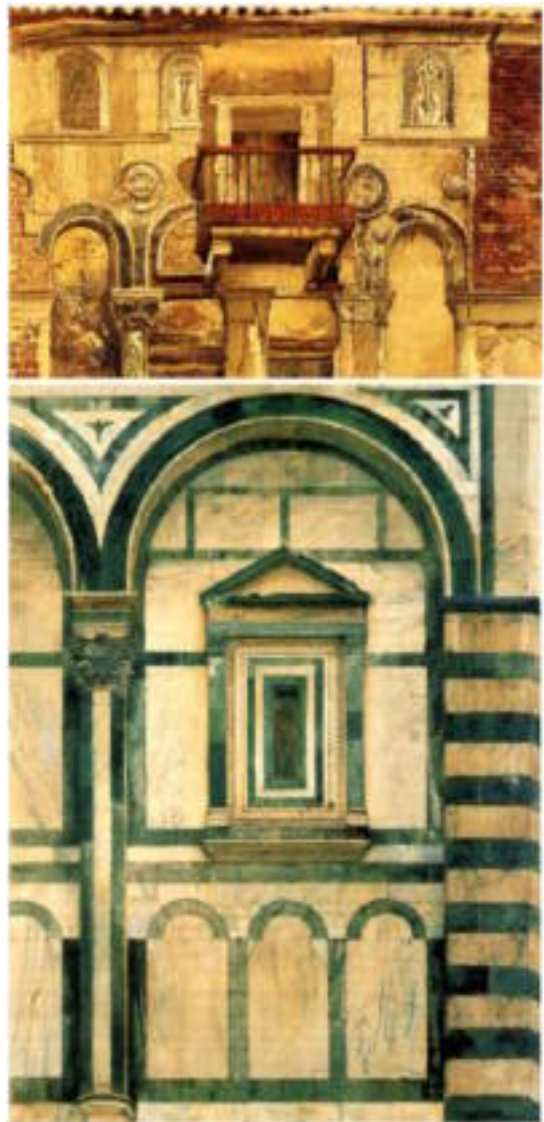


Figure 11. The Fondaco dei Turchi in Venice and the Baptisterium in Florence drawn by John Ruskin

## 7. THE FUTURE OF GEOMATIC

In line with the above, it is clear the positive contribute which may come from the geomatic for the conservation plan, starting from the computerized calculation of the surfaces of intervention and to from the other indications of quantitative and qualitative nature. This is a contribute which will continue to be indispensable, once the conservation works completed, in view of its periodic review and monitoring of control of efficiency of interventions carried out, as well as during the definition of the future maintenance plan with the regular update of the technical cards on the state of consistency of structures and materials.

Acquired that the continuous update of surveying and elaborating plans of information and therefore of the growth and systematize of the databases already available (through the creation of an informatic system a crescent through implementation and integrated information), the vast domain of representation techniques -from the traditional thematic cartography to the automatic and digital cartography, including every form of tele-survey (satellite or aerial) and of territorial information system (SIT)- is destined to become the loyal

privileged companion of any operator in the field of conservation.



Figure 12. The first photo made in Le Gras by Nicéphore Niepce in 1826

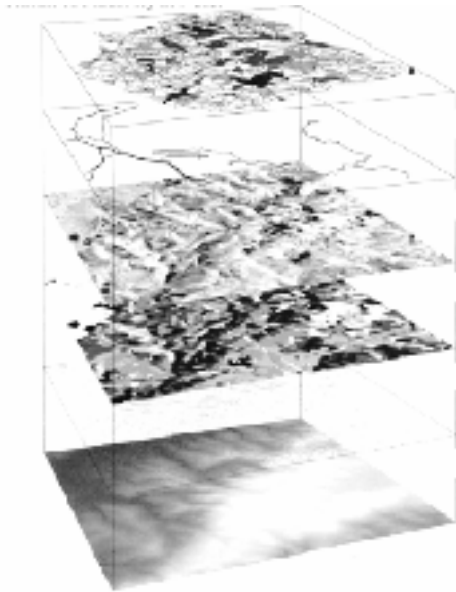


Figure 13. Scheme of a multi-layered GIS

New interdisciplinary and multimediatric *ludi matematici* are going on, such as those related to the definition of very sophisticated mathematic models that simulate the structural behavior or the regulation and the intervention modalities on the widespread Heritage (such as for example through the construction of detailed computerized surveys of walls box system), thanks to the close converging cooperation of all the new operators of permanence (however in the line with the above it is always time relative).

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- (2) Leon Battista Alberti, *De Re Aedificatoria*, (by Renato Bonelli and Paolo Portoghesi), 1966.
- (3) Geomatica = Geos: earth; matica: informatic. In Mario A. Gomasasca, *Elementi di Geomatica*, Associazione Italiana di Telerilevamento, Milano, 2004.
- (4) In order to deepen this matter, I suggest to read his books. As Alberti surveyor history concerns, I suggest Luigi Vagnetti's books, in particular: L. Vagnetti, *La descriptio urbis Romae di Leon Battista Alberti*, in "Quaderni dell'Istituto di Elementi di Architettura dell'Università di Genova", I, ottobre 1968; L. Vagnetti, *Considerazioni sui Ludi Matematici*, in "Studi e Documenti di Architettura", Firenze, 1972.
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- (6) Mario Docci, Diego Maestri, *Manuale di rilevamento architettonico e urbano*, Laterza, Roma, 1994; AA. VV., *Il rilievo dei beni architettonici per la conservazione*, atto del convegno, Kappa, Napoli, 2000. Mario Docci, Diego Maestri, *Il rilevamento architettonico, teoria, metodi e disegni*, Laterza, Bari, 1984.
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Figure 14. Santa Maria Maggiore in Bergamo, photographical straightening and matric-photological survey (Luigi Colombo, Grazia Tucci, 'ANAFKH 1, marzo 1993).



Figure 15. San Francesco al Prato church in Parma, photographical straightening of one chapel

**LE PIETRE DI MODENA - LA STORIA SIAMO NOI  
UN NUOVO INGRESSO ALL'ANTICO PALAZZO DELLA COMUNITA'**



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**LE PIETRE DI MODENA - LA STORIA SIAMO NOI  
UN NUOVO INGRESSO ALL'ANTICO PALAZZO DELLA COMUNITA'**  
(MODENA, 2004)

PROGETTO E DIREZIONE LAVORI: PROE. ING. ARCH. MARCO DEZZI BARDESCHI

ISQUADRAMENTO E  
FOTOPIANO DELL'INGRESSO PRIMA DELL'INTERVENTO

Figure 16. Municipal palace of Modena, photographical straightening of the new entrance hall (Marco Dezzi Bardeschi)