

Considerations on Drawing as a Representation of Space and an Approach to Knowledge

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The values of architectural drawing are multiple: the most immediate is that of drawing as a means for the realization of a work, but perhaps the most important is that of drawing as an instrument for the comprehension of shapes and of the space that is determined by how they follow each other and change.

Indeed, anyone who does not draw cannot recognize and remember, or even understand, the shape of objects, of architecture, of the urban environment, of the territory. I agree with Riccardo Migliari, who wrote: "Therefore, whoever does not draw cannot understand space, nor what it means 'to comprehend space,' and consequently, whoever does not draw cannot even understand the role of drawing in the formation of this intellectual ability

that is so important to the work of an architect" [Migliari 2000, p. 6].

Even Johann Wolfgang von Goethe basically stated: "what I did not draw, I did not see" [Goethe 1875, p. 69].

A large number of papers were presented on this subject at the recent congress in Florence entitled *The Reasons of Drawing. Thought, Shape and Model in the Complexity Management* [1], where one of the issues addressed regarded drawing as a representation of space and an approach to knowledge.

The topics touched on many aspects, ranging from speculative theoretical considerations to formal geometric interpretations, from digital methodologies and graphic codes to three-dimensional evaluations of numerous

* Articolo a invito per inquadramento del tema del focus, non sottoposto a revisione anonima, pubblicato con responsabilità della direzione.

monuments, from the role of sketches to augmented virtual reality. Through experimentation on concrete issues, several contributions sought to clarify the terms 'drawing' and 'representation,' establishing what is the possible and proper value to be attributed to them, but rarely do they venture into the vast field of semiotics, which is another interesting point of view from which to treat the topic and to which new lines of research should be dedicated. But it should be remembered, in resorting to the explanation given by Giovanni Klaus Koenig, that the term drawing denotes and connotes "a homogeneous group of images traced or reported on a two-dimensional surface" [2], on a drawing pad but also, in the light of the instruments available today, on a computer screen. Again Koenig, more than half a century ago, in his lectures for the course on *Elements of Architecture and Survey of Monuments*, as Italo Gamberini's assistant, proposed a very effective comparison when he asserted that architects have always used drawing as a mediated means of representation of a predicted and hypothesized reality: "an architect draws something that, at the very moment in which he draws it, exists only in his mind; and that, due to its complexity, needs to be studied, criticized, reworked, deepened, possibly transformed, reduced or expanded before its real execution" [Koenig 1962, pp. 8, 9].

Many speakers at the conference dealt with the complexity of drawing; among them, Antonella di Luggo argued that: "In its different expressions, such as sketches, technical drawings and survey drawings, a representation appears as a tool able to replace reality, and to communicate it although absent, by virtue of the correspondence between reality and representation, where the latter has the role of a story made by signs and a graphical text translating the constructed reality into a new language, which assumes and transcribes its meaning by discretizing its parts and elements, according to an order of artifices different from mere perception" [3].

The analysis of the relationship between image and mind was resumed, among others, by Andrea Casale, when in his report he emphasized the role of perspective that "due to its particular condition of comparing two identities, the artist's self with the viewer's self", takes on a double meaning: on the one hand, as a means with which "to realize the copy image of reality able to recreate the illusion of a phenomenal vision," while on the other, as testimony of a mental process that sees the "depiction as an application of thought" [4]. Horacio José Gnemmi

Bohogú stressed the connection between image and the drawing of ideas, particularly referring to the value of representations in the process of studying architecture [5]. However, at times it is difficult to distinguish between drawing and idea, when ideas merge with architectural drawing [6]. The study of drawing techniques and theories then becomes a means of research, an object of study and, at the same time, a critical and interpretative tool [7].

The meaning of the word 'representation' is certainly wider than that of 'drawing': it is possible to represent something that has taken on a precise form, be it an idea, a project, or any built environment. In the last few years this theme has been widely discussed. We can briefly say that a project is 'drawn' while its definition is being studied and that the final forms can be 'represented': drawing composes, assembles, summarizes, while representation decomposes, decodes, describes [8].

Drawing actually becomes an interpretation of reality beyond the graphic mark and gives evidence of the cultural background upon which it is developed, and because of which it acquires particular formal features. On this subject, Luigi Cocchiarella asserted the cognitive primacy of the image, especially for architecture, engineering and design, as well as its aggregative role inside complex informative structures, emphasizing how drawing is "a privileged field of symbolic or metaphorical synthesis, facilitating the dialog among operators with various specializations."

In this sense, drawing also offers effective access gates to systems of knowledge traditionally based on non-iconic languages, together with extraordinary opportunities for the dissemination of knowledge. We must act on these levers in both research and education, especially in those intrinsically interdisciplinary contexts such as architecture, engineering, and design, also "keeping in mind the need for welding tradition and innovation" [9].

Another contribution to this topic was given by Fabrizio Gay and Irene Cazzaro, who, in several interesting considerations, stated that the aim of drawing is "to give the most effective expression of the 'figural geometries' of visual objects (natural or unnatural)." In their paper, two developing lines of this discipline are suggested: the first is directed towards the definition of a "notion of 'figural geometry' of bodies that can be divided into a figurative level (iconic and analogical) and a plastic level (gestaltic and mereological);" the second is addressed to the study of "new 'shape' categories, more suitable for understand-

ding large aesthetic artifacts –from cities to ornaments– coming from several models of morphogenesis, especially those of Turing and Thom” [10].

There is no need to disturb communication philosophers and theorists to understand that drawing is formative, because of its particular feature of being a conceptual, rather than instrumental, category. For this reason, drawing, having the ability to rigorously correlate image to shape, must be set in the general context of the world of geometries, establishing a connection with the history of thought and architecture.

Therefore, we must consider, as grounds of every reasoning, the persistence and the immateriality of the effectiveness of geometrical studies in the process of developing a mentality that is suitable to conceive and appraise events in space. Besides, this effectiveness is not compromised by the abundant aids offered by infographics, now prevalent in the world of architecture and design through the complex forms of graphic communication.

The representation of three-dimensional space on the surface of a sheet of paper for obtaining a sensation of depth has always been, to man, one of the main problems to solve. The search for geometrical or mathematical methods of representation, to make spatiality more suited to the reality of vision, is a theme on which we must work, as well as a subject of intense reflection. As an example, the studies of Matteo Flavio Mancini, who suggested a methodology that can measure the impression of apparent depth achieved by painters in their works, an experience that confirms the power of analysis, comprehension and discovery of the instruments of synthetic representation [11].

Architectural representation and architectural drawing are thus the most common intermediary in approaching a real building. Antonella di Luggo took this subject up again in dealing with the graphic production of architect Gino Avena, who worked in Naples from 1930 to 1960, because of his particular attention to the representation of architecture and to its way of appearing in the urban scene: “Architecture makes use of drawing during its construction process and in the ways in which it appears, as representation implicitly establishes an analogy with reality, by accompanying architecture in the different phases of its development, starting from its initial idea, through its ‘designing,’ up to the precise definition of its constructive aspects and far beyond its realization, because, once built, architecture still uses drawing to tell itself” [12].

With this attitude, Giuseppa Novello, during her speech at the congress, underlined the value of direct reference to graphic documents, observed in their original materiality, because sharing knowledge through drawing “is an art that requires intelligence and sensitivity; it also qualifies other processing modes, supporting, testing, challenging them, but it may be considered a powerful ally in the technical field.”

Although the temporal and cultural distance between nineteenth-century engineering and the current one is great and the comparison with today’s practices may appear risky, however, conceptually considering the opportunities offered by the most advanced digital methods for project management, the references suggested by Giuseppe Mosca’s drawings are anything but nostalgic: “their lesson is up-to-date and, if properly understood, might propose unexpected outcomes” [13].

It is unquestionably necessary, therefore, to associate the idea of space with the subject of architectural drawing and to take into consideration the geometrical approach that permits comparison, evaluating the problem of the relationship between Euclidean geometry, ‘the geometry of the mind,’ and projective geometry, ‘the geometry of the eye’ [De Rosa 2003a; D’Acunto 2004].

I think of the studies on Platonic solids conducted by Lucio Saffaro [14], who has always been so fascinated by three-dimensional geometry that he investigated the studies carried out by the great mathematicians of the past; he realized various paintings with regular and semi-regular solids, setting out on a path of research that, through philosophy and metaphysics, examines the representation of inaccessible realities, which, using rigorous geometries also leading to a perceivable and real structure, never become tangible.

During the Middle Ages these principles of control were not found in drawing, but in mathematical geometric procedures: operations of juxtaposing areas, preconceived alignments and dimensioning, ruled construction according to a series of mechanical steps whose validation and control apparatus was totally delegated to the mathematical and geometrical Euclidean moment. That is the reason why the issues concerning the world of architectural conception have always been linked to the genesis of shape, showing particular interest in geometry and numbers considered as prototypes of ideals, as symbols of a highest order. Indeed, geometry has held a role as a powerful instrument for the comprehension, description

and modeling of architectural space, thanks to its nature of being a conceptual tool, founded on formalized theories and, as such, linked to a system of rules, proving to be a successful means for describing the origin of the forms and figures of architectural construction.

Graphic analysis is a very effective instrument through which it is possible to examine a drawing, searching for its geometrical matrices.

This is what Michele Russo proposed in his study of the façade of the Monza Cathedral, in which an integrated experience of architectural survey, photo-modeling, photogrammetric reconstruction and geometrical analysis is shown: "In particular, the methodology adopted, based on UAV photogrammetry and image-based modeling, allowed the creation of a metrical, high resolution orthoimage, which has been used as reference for creating façade drawings, supporting the following material and diagnostic analysis of the wall. [...] This latter aspect pointed out some specific features that are not visible at first sight, confirming that drawing, in its different meanings, remains an irreplaceable instrument of study and analysis" [15].

In the survey of the helicoidal staircase in Caprarola, Leonardo Paris searched for the formal matrix and the geometry that had guided the realization of the project [16]. Similar considerations were presented by Fabrizio Agnello and Mirco Cannella, who underlined how the geometrical analysis of the whole group of volutes in the tree of life in the southern porch of the Cathedral of Palermo reveal a very sophisticated overview involving decoration and the architectural framework [17].

Aiming to define a typological classification of the Ionic volutes found in architectural treatises dating from the fifteenth to the seventeenth century, Veronica Fazzina investigated the geometrical rules for their construction [18]. Geometrical rules at the base of project design were also the aims of research by Laura Aiello in her studies on Le Castella, after a careful historical and archaeological analysis on the basis of which to carry out the survey that became the object of geometrical and constructive reasoning.

The next step the author proposed was the association of conventional drawing to tactile drawing, whose essentiality and need of clarity lead to careful considerations about the work: the realization of bronze or wood models with the demarcation of the macro phases of construction, originally intended for a limited number of

users, such as the visually impaired, has made even more immediate the understanding of very specialized data, made accessible by the immediacy of the materiality of the models adopted. The author claims that "after having made an autoptic analysis of the masonry works and codified their temporal relationships according to the classical methods of archaeological studies" it is necessary to entrust color with "the function of rendering the relative chronology of the walls immediately understandable" [19].

In the past, as well, the control and management of spaces was often left to a model (made of wood, plaster, etc.), often in reduced scale, which for the master builder was an example to follow directly on the worksite, so that the model grew as the construction works progressed.

Today, spatial management, or rather, spatial dynamism management, is resolved by the use of digital models and by the introduction of augmented reality.

Like many others, Guido Guidano and Carlo Battini also dealt with this topic, emphasizing that "the dissemination of knowledge about cultural heritage is the first step towards its preservation and, at present, virtual reality proves to be an effective tool for achieving this goal. [...] The direct experience and knowledge of a piece of architecture enable us to recognize its value and, therefore, to establish a good strategy for its preservation. The more intense the experience is, the more powerful the perceived need to preserve architecture will be. In this sense, immersive virtual reality allows the creation of processes of knowledge even without a specific technical preparation" [20].

Indeed, Andrea Giordano and Chiara Nichele also affirmed that multimedia tools "allow an easier approach to a work of art according to various levels of fruition: depending on the user, on his age as well as his grade of relevant experience, one can choose a visual, terminological and communicative language of the maximum effectiveness. It should be pointed out that this differentiation is made only to provide a hierarchical structure to information, and not to 'alienate' the less experienced user" [21]. Drawing architecture, from a certain moment on, has always been a direct method of study; drawing was the training ground of Architecture. Drawings were an abacus of composition and formal solutions that were important for being able to draw an observed object coherently. Alberti claimed that: "I have examined every ancient building that could be important in any respect, I

have examined them in order to obtain useful elements from them. I've ceaselessly ransacked, inquired, measured, sketched every possible contribution that wits and human industriousness offered me" [Alberti 1782, Libro VI, p. 117]. Emanuela Chiavoni, Francesca Porfiri, Gaia Lisa Tacchi joined this line of research with a paper aimed to gain knowledge, by means of drawing, in all its different meanings, of the Palazzo dei Tribunali court house in Via Giulia, designed by Bramante in the early sixteenth century and only partially completed, and whose only trace is an impression left on the ground: "a few fragments remain of the massive and imposing rustication that distinguished its base" [22].

Vincenzo Cirillo's paper was in line with the previous idea and, through the cognitive function of drawing and of geometrical-structural analysis, interpreted the configuration of the staircase inside Palazzo D'Afflitto in Naples as an intervention of eighteenth-century embellishment. The perceptive study of the stairway to dynamically narrate space is interesting [23].

Francesco Maggio's work aimed to investigate a project, that of the Hôtel particulier by the De Stijl group "which, in the existing bibliography, remained in the fixity of its representations and was never explored with the instrument of drawing, that is an interpretative and critical act of architecture involving, translating and transcribing the idea" [24]. Drawing for the purposes of measurement belongs to the area of so-called scientific surveys, because of the search for an ever-less-mediated objectivity. This need revealed itself in the mid-eighteenth century, when, to conciliate obedience to tradition with the new rational spirit, experts tried to structure, with philological precision, the contents of tradition itself, defining its methods of imitation with great precision. A great number of contributions have arisen since then, particularly by those aiming for a scientific reconstruction of the classic heritage: some examples are the atlas of *Ruins of Palmira* by Robert Wood, or the following *Ruins of Baalbeck* by the same author and the study entitled *The Antiquities of Athens* by James Stuart and Nicholas Revett, where they proposed surveys of Athenian monuments done in 1750, as well as many others. The success of architectural survey continued throughout the whole nineteenth century, as the plates by Paul Letarouilly, among many others, prove. He spent his life surveying Roman architecture, arranging a documentation that, in spite of some inaccuracies, constitutes a landmark for a subject that is still today not marginal.

These are only few examples useful to clarify how measured drawing has been, and is still today, the primary objective for the dissemination and study of architectural models. This dissemination has not always had only a scientific or cognitive nature. Just think of the role of *Ricordi di Architettura* [Bini 1990], printed in Florence between 1878 and 1900, where the divulgation of collective typologies of architecture or the extensive documentation of bourgeois and *petit bourgeois* building is functional to an exact political and economic period. A propagandistic instrument of professional success, strengthened by the direct comparison made using surveys of appropriate monuments or ancient architectural elements.

This does not detract from the subjective validity of the published drawings, that remain, having lost their original significance, a valid means of gaining knowledge for modern scholars, thanks to their careful execution and reproduction.

The wealth of surveys published has greatly increased in the last decades, due to the development of architectural and historiographical publications and to the improvement of the quality of the measurements and graphic restitutions.

In fact, nowadays automatic drawing and instrumental survey can provide documents that are very dimensionally reliable and graphically normalized, which ensures ease of recording and comparison. Electronic data processing enables us to digitize and memorize a huge amount of elements, so as to permit cross-comparisons which in a very short time can give us information that otherwise would only be available with a great waste of time and energy.

Alfonso Ippolito and Martina Attenni, starting from studies on lost archaeological heritage and the relationship between text and image that results from three-dimensional modeling, supported the appropriateness of using digital archives that "can affect the divulgation of information, not always disseminated on a large scale because of space and costs. [...] The application of all innovative technologies ensures the possibility to exchange objective data that are open to further interpretation" [25].

Today the dimensional component of architectural survey drawing can be easily investigated by the means at our disposal. Both the knowledge of the evolution of the way to tackle the problem of representing built architecture and the modern techniques available to the

draftsman-surveyor are aspects considered in many papers presented at the congress. But there are also other components that interest an architect during his dealing with the object to be surveyed: the volumetric-morphological, environmental, material and chromatic features. Many contributions addressed this subject, although the graphic results of a survey are not always originally analyzed and considered: "In particular, survey always results as being the most common topic of our applied research, together with modeling, to which it is often associated for reconstructions of buildings and urban contexts [...] but also –and unfortunately, on a great scale– as technicians who carry out surveys and restitutions and little more, without significant differences and specificities compared to other scientific-disciplinary areas. This is a limit that must be surpassed" [26].

Drawing is not always used in every situation to read and then to represent the existing reality and to verify the design, employing drawing as a means of critical analysis. In some papers, survey drawing is at the base of a critical reading supported by historical-archival and iconographic sources. Following these procedures, Alessandro Bandinelli, Marco Giorgio Bevilacqua and Ewa Karwacka were able to obtain a good level of knowledge of the Charterhouse of Calci [27].

In realizing survey drawings, we schematize and make choices, but we cannot stop with the perception of an object, we must explore its peculiarities and characteristics extensively; in this way, we will be able to get closer to its global understanding, though aware that we will never reach it.

This aspect of surveying must be pursued if we want our works not to be the mere acquisition of graphical and instrumental techniques, but a cultural growth and thus an ability to evaluate not only the dimension of architecture, in the sense of measurements, but even its dimension as a continuous connection between man and his way of being in space.

Then making a survey drawing will mean investigating these aspects, and connecting them to each other, understanding how much contents are important for understanding their many characteristics.

It will thus be possible to retrace most of the steps the designer took, from the ideation to the realization of the work and to any following modifications. This is what José Antonio Franco Taboada wanted to show us through the study of Alvaro Siza's drawings; according to the

author, the architect's travel sketches can be seen as a graphic document of inestimable value when we intend to study and understand the creative process that gave birth to architecture, establishing an inner path of project design [28].

Piero Sanpaolesi, recognizing survey as the only valid instrument for a full and thorough awareness of the spatial values of architecture, a knowledge proven through many years of work in the field of restoration in Italy and abroad, rightly wrote many years ago: "from this point of view a good survey is identified with the history of the building, it reflects the chronological and formal stages and verifies the formal diversities, it emphasizes the temporal sequences and records their anomalies, it clarifies static reasons and encloses, in a small space, in plain sight, their shape" [Sanpaolesi 1973, p. 62].

In addition, the building's texture and history can be read with a careful survey which, besides measurements, takes into account the messages that the stone document holds. Cecilia Maria Roberta Luschi reminded us of this feature, noting that in survey projects, graphic symbols used on ancient walls, including stonemasons' marks, have often been neglected: "instead, taking into account all the symbolic corpus distributed on masonry structures, the graphic outcome of a survey project is enriched by data that can influence judgements and provide ideas about the building being studied and the organizational method of the execution phase" [29].

On the other hand, drawing, in this operation of synthesis and choices, as already mentioned, is not only 'representation of elements with visible marks on paper,' as in ordinary usage, but "thought, intention, project, plan." We could continue with the words of Quaroni, who defines drawing with "the dual meaning of invention-design and of graphic operation for the construction-communication of the invention itself" [Quaroni 1977, p.32].

When applied to graphic processing of survey restitution, the term drawing, in my opinion, does not fundamentally change its meaning: indeed, reversing the two definitions we have 'design of the invention' and "communication of the construction" with the meaning, in the first case, of individual reasoning of the operator-architect in search of the thread of the story, the motivations, the mechanisms, and in the second case, the communication of information to others about the contents acquired by the operator-surveyor.

These considerations are not new: they have been made by architects and artists ever since the Renaissance,

when survey was considered an irreplaceable instrument of knowledge. This is widely testified to by Vasari in his *Vite* when he refers, for example, to the activity of Brunelleschi in Rome between 1402 and 1407: "And so, having set out to measure the cornices and to draw the plans of those buildings, he and Donato persisted, sparing neither time nor expense. There was no place in Rome or elsewhere in the countryside, that they left unvisited, measuring what they thought good for their purpose" [G. Vasari 1568, p. 299]. And even when he tells about Ghirlandajo "portraying the antiquities of Rome, arches, baths, columns, colosseums, obelisks, amphitheaters, aqueducts, he was so good at drawing, using only his eyes, without a ruler, or sextant or measures" with considerable accuracy, as later the masters confirmed through verifications "after his death" [G. Vasari 1568, p. 476].

Architectural drawing is still undoubtedly the first vehicle of communication of artifacts in their present state, in the possible formal interpretations and in the process that organizes the future construction; especially now that digital technology allows three-dimensional calculations of effective technical and visual impact.

Pierpaolo D'Agostino focused on these topics, identifying the margins of adequacy of digital tools for supporting graphic representation, and how these new forms of communication relate to technological and cultural innovations, and how not only a lexicon is missing, but there is not yet even a basic grammar [30].

This topic was resumed in the report of Renata Pinedo Valdiviezo, who pointed out that the current technological tools have dehumanized graphic information, because the hand, and thus the pen, is not the direct extension of the brain [31].

The technique of drawing, at least until a few years ago, is essentially directed to the formation of images in which the values of the point and, above all, the line, are dominant. This has come about thanks to the peculiar characteristics of the means of expression, for instance pointed tools for writing or drawing such as pencils or pens. Today, interest has gone beyond and shifted mainly to the study of surface and volume. Numerous authors were interested in the graphic results of three-dimensional survey, proposing descriptive digital models of architectural artifacts as a means of mediation between reality and its representation.

The ability to automatically create technical graphics evidently frees resources that can be devoted to the development of ideas and approaches to research.

Many explanations have been given in recent years on the role of information technology, particularly in the field of architecture: on the one hand, for its role in infographic drawing, a true technical innovation to which, within a few years, all architectural and engineering firms have had to adapt; and on the other hand, for its potential in the field of three-dimensional modeling that truly represented a revolution in the field of representation for having introduced, next to the two-dimensional graphical model, a typical product of descriptive geometrical elaborations, and to the physical model in wood, cardboard, metal, etc., a new model that allows users to operate and apply spatially, with great speed and high geometric precision, procedures capable of visualizing environments and even moving objects.

All this precisely for the fact that what previously could be developed only with manual operations and careful reasoning, now can be done better and in less time automatically, generating virtually investigable models from which to produce, with simple commands, the canonical projections of the object such as plans, elevations, sections, axonometric views, perspectives, but also shading and shadows as well as chiaroscuro effects and other particular effects.

The research team coordinated by Fabrizio Apollonio and Marco Gaiani addressed the issue of digital visualization as a representation of a past that no longer exists, presenting a study case as an expression of a methodology that aims to combine informational aspects with scientific precision. The proposed methodology intends to be a possible answer to the multidisciplinary approach which characterizes the survey of the architectural heritage of the past where the reconstructed models, if scientifically substantiated, become shareable and transmittable documents for study [32].

The studies of Carlo Bianchini also focused on the subject of virtual restitution of ancient architecture as a tool for the research and communication of cultural heritage; they achieved the goal of "showing to the scholarly community (even the most recalcitrant in using digital technologies) the potential offered by 3D modeling, not only and not so much in terms of 'drawing,' but above all as an environment in which to explore, evaluate and make concrete re-constructive hypotheses" [33].

This topic was again discussed by Mario Centofanti, Stefano Brusaporci and Pamela Maiezza, who in their report rightly argued: "The theme of surveying is interrelated to

that of 3D modeling, considered not only as a summary of the results of research, but as a visual tool for studying, data processing and discussing the features of architectural artifacts, of their history and of their constructional and design vicissitudes" [34].

In addition, the paper of Paola Puma, dealing with similar issues, described the work done to document, with low-cost, quickly-executed 3D modeling, archaeological finds of fine workmanship coming from a tomb of Narce, an ancient city near Viterbo. In addition to validating the expeditious process experimented and the metric quality of the results obtained, particular attention was paid to the reliability of the visual qualities: "for better appreciation of the artifacts, in all their material, chromatic and formal characteristics, the models have been enriched by photorealistic textures" [35].

Geometry has played a powerful role in understanding, describing and modulating the existing or prefigured architectural space, because of its character as a conceptual tool based on formalized theories linked to a system of rules, proving to be a particularly effective tool for describing the genesis of the forms and figures of architectural construction.

Infographics, as compared to the methods of representation, involves only a noticeable modification of the operative medium which, unlike traditional geometry, functions analytically and not synthetically, offering the advantages of rapidity in the formulation and implementation of endless views, facilitating the control of complex shapes whose two-dimensional views often do not completely satisfy the representation of their plastic qualities.

This was confirmed by the researches of Paolo Clini, Ludovico Ruggeri, Antonio Corso and Gianni Plescia, which allowed them to obtain, "using low-cost, semi-automatic and non-invasive techniques and methods, processed 2D graphics at high resolution of a fine engraving on marble slab" giving "the opportunity for the study and digital cataloguing of architectural drawings of the Greco-Roman world" [36].

The wealth of dedicated programs must not, however, make us forget that the formative values of a discipline cannot be replaced or otherwise left in the background compared to operational methodologies; often the excessive laboriousness of the instrumental phase of a logical process shifts the commitment to learning from conceptually fundamental contents, that govern the operation, to the mere knowledge of mechanized proce-

dures without understanding their meaning [De Rubertis 1976, p. 5].

Another aspect, that must not be underestimated, concerns the ability of a computer to store a huge amount of data that could lead the operator to define the shape to be represented by recurring to an excessive amount of graphic information, so that the drawing would lose its characteristics of synthesis and critical analysis, essential for an evaluation of the objects to be represented, strongly linked to the final representation scale of the artifact. In spite of the fact that descriptive geometry, as Monge codified it, is addressed to the diffusion of a technical training able to use drawing as an instrument for the control of graphic design operations on three-dimensional objects and as a moment of study of their geometric properties, it appears legitimate to propose a reflection on the redefinition of the codes of representation, firmly anchored to geometrical bases, but seen in the light of a radically modified cultural context.

Digital images should be considered from this perspective, as their vision no longer has any reference to the position of an observer placed in a 'real' world, optically perceived with the rules encoded since the days of Brunelleschi and his prospective tablet; the visual effect is instead attributable to the mathematical and electronic data that compose and make them perceptible through millions of pixels that characterize them.

Reality becomes more and more immaterial "and increasingly, the visuality" states Agostino de Rosa, "is thus destined to be placed on a cybernetic and electromagnetic terrain in which linguistic and abstract-visual elements coincide, and they will be consumed, circulated and exchanged in global form" [De Rosa 2003b, p. 14].

But it is still necessary to know the fundamentals of the theory for the construction of an image, at least for staying in touch with the procedures and rules of traditional drawing. Eduardo María Baviera Llópez, José Luis Denia Ríos, Jorge Llopis Verdú, Jorge Francisco Martínez Piqueras, in presenting their work on the use of laser technology, claimed that this technology is the one that gives the most interesting results regarding purely architectural survey, but we must still ask whether such a large amount of data can be, in some way, improved and completed [37].

With drawing, as with virtual reality, we may run into counter-productive attitudes when the tool of representation is considered a means of reproduction or imitation

of reality, without recognizing its tremendous analytical potential, its fundamental role as an instrument of understanding able to re-shape reality, whose computer-assisted modeling combines the complete definition of the three-dimensional conformation of physical models with the abstraction of traditional geometric representations, making it possible to realize all those perceptual operations of measuring, of control of the position of a shape in the 'virtual space of the computer.'

To fulfill the operations that characterize the principal activities of an architect who must operate, build and reason in space, a dynamic virtual model with its images in continuous mutation inside and outside the studied or conjectured object is a useful aid for imagining or pre-figuring architectural space. Also for this reason, Michela Cigola, with Saverio D'Auria, Arturo Gallozzi, Leonardo Paris and Rodolfo Maria Strollo rightly argued that "digital technology can be an important means for optimizing resources for the conservation and enhancement of the cultural heritage so widespread throughout our territory" [38].

In conclusion, we can say that the graphical language of drawing, through its stringent codes of representation, must remain one of the foundations of project design training, architectural documentation and analysis. Traditional drawing, however, has been joined by other powerful expressive and communicative means, such as computer graphics and digital modeling, that we are learning to manage and make the most of both in research and theoretical fields, but especially in professional training. Ultimately, however, "the practice of drawing [...] remained the only physical relationship that the architect carries out with the physicality of matter that has to be shaped: it is his last 'manuality' and he must defend it fiercely" [Gregotti 1985, p. 65].

Notes

[1] The 38th International Meeting of Teachers of Representation Disciplines, XIII Congress of the Italian Union for Drawing, entitled *Le Ragioni del Disegno/The Reasons of Drawing*, was held in Florence, Italy, on 15-16-17 September 2016. Proceedings: Bertocci, Bini 2016.

[2] Koenig explains that the graphic mark does not merely denote something, as is the case for the marks of spoken language, but it connotes something, that is, it represents it, in other words, according to Moria's theory, this means that an image is an iconic sign, i.e. it has some properties of the denotatum. In Koenig 1964, p. 41.

However, regardless of the tool for drawing, when there is no clarity of intent, confusion can arise: Michel de Frémin, as well, warned about this problem in his *Memoires critiques d'architecture*, when, at the beginning of the eighteenth century, he affirmed: "I always disagree with those who make a well-finished drawing, but where there is no precise relationship of the idea with the result [...] I cannot endure a man who dares to affirm that he is teaching drawing, nor young ingenuous people who believe that by frequenting this so-called 'Doctor in Drawing' to learn how to draw lines on a piece of paper, they will master drawing; this practice is repugnant to my reason; indeed, learning to draw means obtaining inventive skills and discernment in invention: in a word, having a wealth of intelligence and imagination, through which a man finds all the means necessary for performing all kinds of good projects" [De Frémin 1702, Letter VI, p. 19]. I would like at this point to make a further consideration, suggested to me by a comment that Umberto Eco makes in his book *Come si fa una tesi di laurea*: "Photocopies are indispensable instruments.

They allow you to keep with you a text that you have already read in the library, and to take home a text you have not read yet. But a set of photocopies can become an alibi.

A student makes hundreds of pages of photocopies and takes them home, and the manual labor he exercises in doing so gives him the impression that he possesses the work. Owning the photocopies exempts the student from actually reading them" [Eco 1977, p. 139].

So, to paraphrase Eco, it is possible that the possession of the graphic elaboration of a survey, whether digital or not, with all its fascinating, but in some cases mysterious values, exempts us from actually having to reach a true awareness of the object represented.

[3] Di Luggo, A. (2016). Figurative variations on modernità. In Bertocci, Bini 2016, p. 279.

[4] "If the first considers perspective as the instrument for demonstrating the objective certainty of a fact, the second considers it as a demonstration strictly linked to the abstraction typical of a mathematical process. The first regards perspective as the proof that from the phenomenon, thought can be reached, the second, as the way to explain thought through the phenomenon": Casale, A. (2016). Experimenting with Perspective. Particular relationship between the image and mind. In Bertocci, Bini 2016, p. 171.

- [5] Gnemmi Bohogú, H.J., (2016). Writing Image, drawing idea. About the value of representations in the process of studying architecture. In Bertocci, Bini 2016, p. 367.
- [6] The authors assert that at times it is difficult to distinguish between drawing and the idea it represents, because they merge. Vallespín Muniesa, A., Hernández, L.A., Cabodevilla-Artieda, I. (2016). The idea in architectural drawing. In Bertocci, Bini 2016, p. 643.
- [7] Bortot, A., Zoerle, S. (2016). Perspective models in the dissemination of knowledge. An engineer, a religious and the *magia naturalis* representation. In Bertocci, Bini 2016, p. 137.
- [8] On the topic of drawing/design, among the several published contributions, see the essays by Manlio Brusatin (1978); A.A.VV. (1983); Vittorio Ugo (1988); Margherita De Simone (1990); Roberto de Rubertis (1994); Livio Sacchi (1994); Carlo Mezzetti (2000); James S. Ackerman (2003); Roberta Spallone (2004).
- [9] In his interesting paper, the author underlined that “the intrinsic syncretism of digital means gave a second possibility of interaction to sciences and art. And if on the syntactical level the connection is ensured by the homogeneity among algorithmic codes, on the operating level this relationship appears to be clearly supported by the image, as the connecting semantic interface in intricate modeling contexts”. Cocchiarella, L. (2016). The reason of the reasons: image and knowledge. In Bertocci, Bini 2016, p. 229.
- [10] Gay, F., Cazzaro, I. (2016). Drawing the indiscernible: morphogenesis & morphography of the artefact. In Bertocci, Bini 2016, pp. 339.
- [11] Mancini, M.F. (2016). The illusory depth of perspective illusionism. Experimental analysis on Andrea Pozzo’s Glory of St. Ignatius in Rome. In Bertocci, Bini 2016, pp. 447-454.
- [12] Di Luggo, A. (2016). Figurative variations on modernity. In Bertocci, Bini 2016, p. 279.
- [13] Novello, G. (2016). Drawing with art and measurement: a lesson inspired by Giuseppe Mosca’s drawings prepared to show quantity take off and building management for the construction of the bridge over Dora river, in Turin. In Bertocci, Bini 2016, p. 506.
- [14] Lucio Saffaro was born in Trieste in 1929; he took a degree in pure physics at the University of Bologna. He was a painter, author and mathematician. Starting from the 1960s he established himself as one of the most original and unusual figures of Italian culture. His study on the definition of new polyhedrons are included in various of the author’s essays and have been the subject of conferences held in Italy and abroad.
- [15] Russo, M. (2016). The complex façades representation for constructive schema generation and matter analysis: the case study of Duomo in Monza. In Bertocci, Bini 2016, p. 617.
- [16] Paris, L. (2016). The helicoidal staircase at Caprarola by Jacopo Barozzi da Vignola. Formal innovation between theory and practise. In Bertocci, Bini 2016, pp. 523-530.
- [17] Agnello, F., Cannella, M. (2016). The tree of life in the southern porch of the Cathedral of Palermo: survey and geometric analysis. In Bertocci, Bini 2016, pp. 35-40.
- [18] Fazzina, V. (2016). Graphic analysis as instrument of knowledge: study of the geometry of the ionic voluta in architectural treatises from XV to XVII century. In Bertocci, Bini 2016, pp. 311-318.
- [19] Aiello, L. (2016). The drawing for understanding the architectural artifacts. Le Castella case. In Bertocci, Bini 2016, p. 47.
- [20] Guidano, G., Battini, C. (2016). Tradition and innovation in the design of relief for the knowledge of the building. The case study of the Church of S. Agostino della Cella, Genoa. In Bertocci, Bini 2016, p. 387.
- [21] Giordano, A., Nichele, C. (2016). The representation for knowledge, elaboration and communication between research and touristic-cultural enjoyment: the central-plan ideal church, painted and built in the second half of the fifteenth century in Italy. In Bertocci, Bini 2016, p. 357.
- [22] Chiavoni, E., Porfiri, F., Tacchi, G.L. (2016). Using drawing to analyse a Bramante building: from interpretation of a fragment to the design genesis. In Bertocci, Bini 2016, p. 195.
- [23] Cirillo, V. (2016). The D’Aflitto Palace staircase scenographic drawing. In Bertocci, Bini 2016, pp. 209-216.
- [24] Maggio, F. (2016). De Stijl and architecture. L’*Hôtel particulier*, graphic transcriptions. In Bertocci, Bini 2016, p. 431.
- [25] Ippolito, A., Attenti, M. (2016). ‘Ἐκφρασις’ (ekphrasis): a problem of representation. In Bertocci, Bini 2016, p. 401.
- [26] Cardone, V. (2016). Preface. In Bertocci, Bini 2016, p. 19.
- [27] Bandinelli, A., Bevilacqua, M.G., Karwacka, E. (2016). The architectural survey drawing as an investigation instrument. The case of the Calci Charthouse. In Bertocci, Bini 2016, pp. 63-68.
- [28] Franco Taboada, J.A. (2016). Travel sketches that tell the story of a project’s conception process. The example of Álvaro Siza. In Bertocci, Bini 2016, pp. 325-330.
- [29] Luschi, C.M.R. (2016). Signum supra Lapidem. In Bertocci, Bini 2016, p. 425.
- [30] D’Agostino, P. (2016). Codex in the digital era. Thoughts on the new needs and requirement of graphic technical representation. In Bertocci, Bini 2016, pp. 265-270.
- [31] Pinedo Valdiviezo, R. (2016). Analog to digital. In Bertocci, Bini 2016, pp. 569-576.
- [32] Apollonio, F.I. et al. (2016). Digital reconstruction of Piazza delle Erbe in Verona at XIVth century. In Bertocci, Bini 2016, pp. 57-62.
- [33] Carlo Bianchini asserts that: “Moreover, this research project presents not one of the ‘best there and then’ reconstructions (which

it might actually be...) but, as Fig. 9 clearly demonstrates, it is certainly one of the most explicit in terms of evaluation of the reliability levels of its elements. In this perspective it can be defined as a good practice of an operational methodology able to prove once and for all the intrinsic value of 3D models as scientific as well as communication means. These two terms are not separate: communication (even if simply informative) and scientific research actually support each other; especially in the field of architecture and, more generally, cultural heritage. More reliable interpretative models are, in fact, also more effective and complete [...] also susceptible to being used as the basis for different products more oriented to dissemination, information or even for gaming, cinema or other sectors connected with the so-called Cultural and Creative Industries": Bianchini, C. (2016). Beyond communication: 3D heuristic models in architectural research. In Bertocci, Bini 2016, p.115.

[34] Centofanti, M., Brusaporci, S., Maiezza, P. (2016). "The House of School": architectures for education in the first half of the XX century. Survey and knowledge. In Bertocci, Bini 2016, p. 185.

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[37] Baviera López, E.M., Denia Ríos, J.L., Llopis Verdú, J., Martínez Piqueras, J.F. (2016). *Digitalized metric survey of the laboratories building at Fonitles Sanatorium using three different technologies*. In Bertocci, Bini 2016, pp. 73-82.

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