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Rappresentazione tradizionale e digitale come linguaggi per l'analisi ed il progetto d'architettura
Traditional and digital representation as languages to analyse and design architecture

Se pensiamo allo stato di necessità che unisce la figurazione architettonica col rilievo ed il progetto, facilmente riusciamo a spiegare gli interessi, che nel tempo hanno caratterizzato l'evoluzione dei metodi per rappresentare: le forme architettoniche ed i loro assetti nascono per l'operatività della rappresentazione, ne sono una conseguenza diretta, nel senso che quelle forme e quegli assetti appartengono precisamente all'universo delle sue possibilità.
Il linguaggio informatico può svolgere lo stesso ruolo che la rappresentazione ha avuto in passato, può, cioè, favorire lo studio di nuove forme e diventare fattore attivo sia per l'analisi e l'ideazione delle disposizioni architettoniche, che per la messa a punto di inedite modalità espositive, o di modalità, per così dire, canoniche della rappresentazione digitale.

If we think to the relationship, or rather to the state of necessity, which unites the architectonic figuration with the survey and the project, we can easily explain the interests that have characterized the evolution of methods and geometric rules for representing: the architectonic forms and the frameworks that we know come up as a consequence of the operative necessities of representation and geometric rules, in the sense that those forms and frameworks properly belong to the universe of their possibilities.
The computer language can have the same role that the traditional representation has had in the past, namely it can help the generation of architectonic forms, becoming an active factor both for the creation of new dispositions for the projects both for the definition of new research methodologies, or of methodologies, canonical for the digital representation.

Parole chiave: rappresentazione come linguaggio, rilievo dell'architettura

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The long tradition, interest and studies which over the years have characterised the evolution of graphic representation methods and norms is simple to explain if we reflect on the relationships between architectural *figuration, survey* and *design*, or better still the need for these relationships. Architectural forms and their orders are created through representation and are directly based on the latter, in other words they belong specifically to the broad options provided by representation. The figurative language behind all phases of an architectural project – be it survey or design – is used not only to illustrate the features of a work, but, more precisely, to invent and interpret it.
When the relationship between traditional representation and architecture became less critical, in other words when the bond mentioned earlier was broken by the advent of the *computer*, then traditional representation and its rules stopped being updated. It's as simple as that; the reasons are straightforward and - let's admit it - almost predictable.
Whether or not we should teach descriptive geometry, digital representation or the principles governing contemporary architectural forms in schools of architecture or engineering is a totally different story; these principles are still valid as a way to understand architectural forms.
In addition to traditional graphic design methods and rules (possibly explained and made more explicit using *software*), computers can fulfil the same role played in the past by traditional representation, in other words they can help study new compositions and become an *active ingredient*[1] in the analysis and ideation of architectural norms and the development of unusual forms of presentation or so-called traditional digital representation methods.
Every designer uses representation to create architectural forms and images and *graphic devices* to check how they evolve; even perception has explicit organisational rules as well as premises to understand an architectural or urban order. Every draughtsman uses representation to find a way to define architectural meanings and continue his research: images are theories to be checked – for surveyors and designers they become a chance to learn from what they are doing.
The fact we use computers to draw doesn't change what I've just stated: today's *software* tends to propose familiar graphic figures and setups without really revolutionising the concept of representation. However there is obviously a change in the order in which problems are solved, as well as in the options provided to study and solve them: for example, with a *computer* it's easy to repeat the designs of plans or volumes; even complicated graphics can be simplified. We could say that the importance of digital elaborations is still linked to the possibility of *pre-figuring* design features and acting *independently* from reality (distance between representation and reality, methodological evolution, scale ratios and graphic mediation techniques, complexity and relevance of figurative choices…). When we use them, however, the same traditional laws and expertise apply.
If we tend to consider the historical evolution of representation as a gradual revision and updating of norms and methods, during several periods in history certain methods and figurative features were repeatedly used; this proves that drawing always maintained the same quality and never became outdated. Leon B. Alberti encouraged architects to represent "without any regard to the shades [and to depict] his relieves from the design of his platform (…) using real angles and fixed lines[2]." Raphael also recommended the same method, dividing the drawing of buildings into three parts.
Quite a jump forward: after the discovery (or invention) of perspective and people's enthusiasm for this new method, Raphael – like Leon B. Alberti – distinguished between the figuration of an architect and that of painters: vertical corners have to be "perpendicular above the base line"; "dimensions should not grow smaller towards either end of the building (…) to make the building show two faces, as some are wont to do"; "when buildings do diminish … this is a technique belonging to perspective drawing, and perspective drawing may belong to the painter but not to the architect". Although not defined as projective, the orthogonal method became an undeniable opportunity: in survey, as in design, we need practical figurative modes "in order for all measurements to be correctly described and in order for all the parts of a building to be identified without error".[3]
Apart from these initial references, what I want to stress is that the peculiarities and ways in which the special features of every drawing are organised enhance the importance of the images. Everyone's representation (method, scale, or graphic technique) is unique; it is a way to reveal our intentions, choices and, ultimately, our own identity. The drawings executed by surveyors and designers react to real things; they don't simply provide answers to problems already posed; instead they gradually focus on issues which involve not only the questions but also the answers.[4]
We shouldn't forget that Giovan Battista Piranesi and Giuseppe Vasi, who, a few short years apart from one another, used different styles and graphic tools to portray very dissimilar, even contrary, images of identical places in the city – even though they used similar figurative methods.
In a view of Piazza di Spagna, Piranesi frames the "emptiness" of the city from an off-centre location beyond Via Condotti; from there he captures the vastness of the square as well as the city as a whole, so much so that it's almost possible to make out Piazza del Popolo at the end of Via del Babuino. In the centre, the Barcaccia and Spanish Steps finished in 1726 to solve the problem of urban décor and connect the Church of Saint Francis of Paola to the area below.
Every detail in the painting helps illustrate the features of this urban area which begins, graphically, with a strong foreground – established by the vertical corners of the buildings, the shadows on the ground, the rugged terrain and carriages – and continues with the shades and nuances he adapts and uses to depict each monument and building (Fig. 1).
"Vasi's cold engraving",[5] executed more or less at the same time, only depicts the monuments (fountains, steps and church), ignoring the

1/ Giovan Battista Piranesi, View of piazza di Spagna, c. 1750. The empty urban space is framed from a standpoint beyond via Condotti; using the graphic device of an off-centre view Piranesi can portray the large square with the Barcaccia in the middle, the Spanish Steps, and the wider urban environment.

relationship between the buildings and architectural objects, or the conformation of the urban area (Fig. 2).
Piranesi is careful to portray every variation in form and volume; each sign helps to differentiate the various elements and underscore differences. Even the contrast between light and shadow helps to emphasise the recognisability of the area and its architectures.
Instead in Vasi's image the details tend to loose depth and even though his geometry is accurate it often makes the arrangement of the built volumes stiffer, making them look like position markers rather than the protagonists of the urban scene.
Piranesi's use of a *graphic device* to portray an off-centre view conveys depth and the elements present in the scene; instead in Vasi's engraving perspective is used to emphasise axiality, to the detriment of reality, and when symmetry is basically irrelevant to the overall interpretation.
I would also like to emphasise that graphic devices help us determine the author's strategy and the drawings become finalised for that goal: images are chosen and arranged in order to study, select and enhance the contents.
Between the late sixties and early seventies, the *Five Architects* routinely used oblique axonometric projection in their designs, but each group member used different graphic devices intrinsically focused, so to speak, on the formative requirements of the design. For example, in the design for the *Bye House* (1973), J. Hejduk used axonometric projection to understand how to build the architectural form and establish how it *developed*.
A designer proceeds in horizontal layers, but in drawings what's important is the creation of the overall picture rather than the planimetric orders and this is achieved by *turning* the plan into an elevation. During this procedure, axonometric projections not only control the end product, they become the practical tool and instrumental method to create a design; an operation that the designer emphasises by aligning two axonometric axes in his graphic device.
Perception is not used to check whether or not a design drawing is valid, so axonometric projection is the tool that gives the best result – the only one capable of producing a plan and elevation illustrating the design idea and geometric forms (Fig. 3).
The advent of digital representation hasn't made the operational relationship between

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2/ Giuseppe Vasi, View of piazza di Spagna, c. 1750. Vasi only portrays the monuments, ignoring less important buildings and reference to the conformation of the urban environment.

the draughtsman and representation any less important. The use of *computers* and dedicated *software* certainly changes the order in which problems are solved, but as per traditional drawings, formative choices still depend largely on the *evidence* of the graphic context and the actions and simulations which can be carried out as the work progresses.
As mentioned earlier, the first effects – apart from the results – produced by digital drawings are linked more to the *procedural tools* (or functions) of the *software* rather than the "concept" of representation which remains a non-verbal *language* with evident formative possibilities in architecture.
From an educational point of view, our first focus is on how to manage the data and use numeric expressions, expressions which behave very differently from traditional ones. We no longer have to use projections (straight lines, alignments, geometric properties…) to establish figures or reverse planes; we use calculation processes which work with coordinates of points and are accurate, fast, easy to rectify, etc. - far better than what we could do using traditional methods. Numerical data management allows us to directly create volumes and provides endless new opportunities. In some ways, it's as if solid modelling allowed us to work with a real-life scale model, but also provided truly endless experimental options; this depends, as mentioned earlier, on the procedural tools of the *software* which become active factors to analyse and create architectural forms. tools
Another issue involves the *economical description* (less signs and figures, reuse of drawings for later projects…) of traditional representation which tends to give each figure a *generative finality* firmly linking it to the specific architectural problem. This generative finality helps to focus on a goal, but is above all useful to establish a direct link between action and outcome. Normally when a drawing stops inspiring us or stops producing new knowledge, we draw a new one. On the contrary, a computer continues to elaborate on the same drawing; it tries several options – all graphically perfect – but uses a method that is basically the opposite to the one we use with traditional drawings where we go back to the first marks we made and where even approximation can help produce something new; in other words, the rather unsteady signs in the early stages of the drawing are not due to our initial confusion – or inexperience – but

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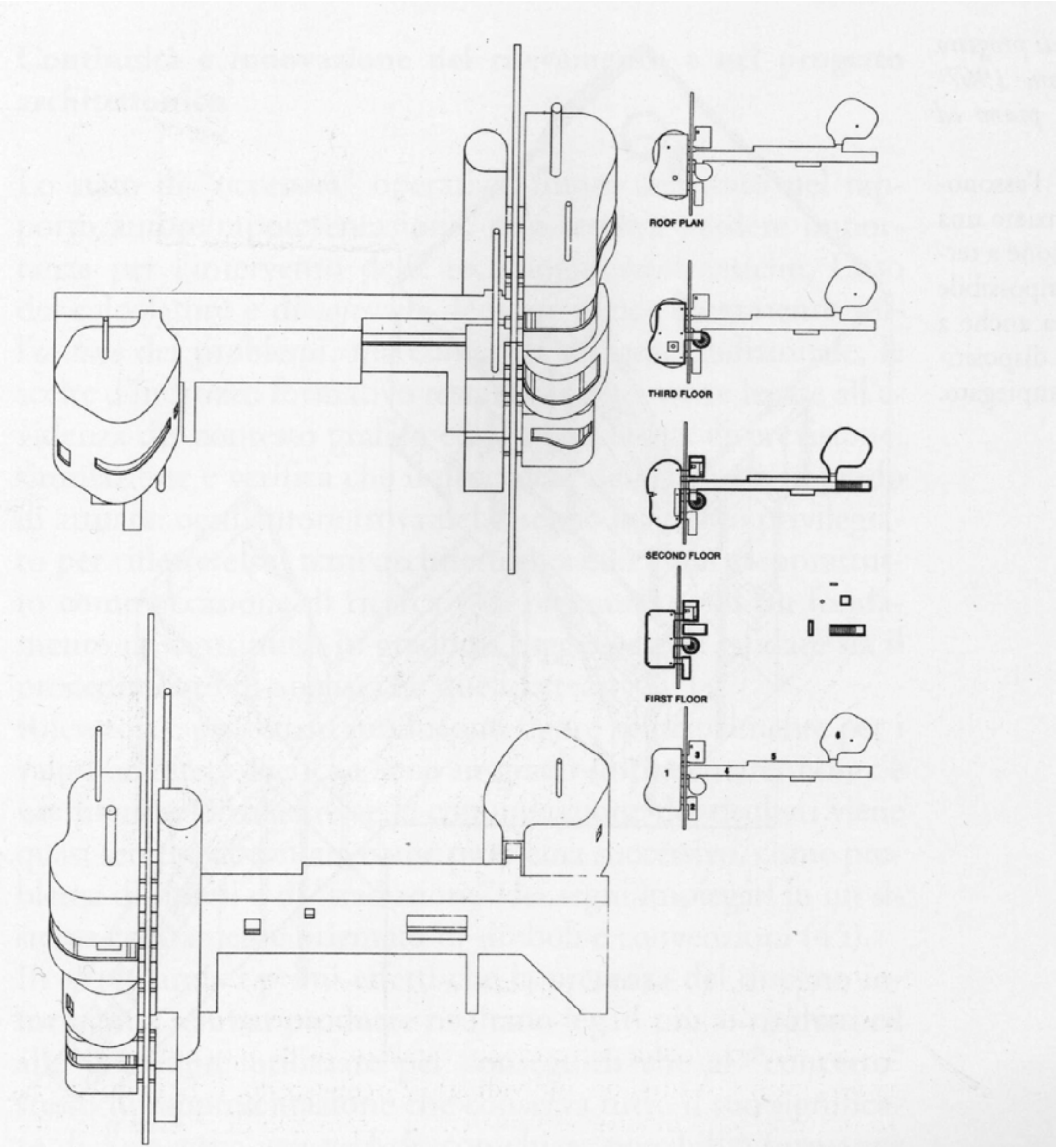

3/ John Hejduk, design for the Bye House, 1973. Hejduk uses oblique axonometric projection to decide how to create the form and establish its generative process.

an attempt to portray multiple choices before making a decision. Computer-generated drawings never have incorrect signs or measurements: due to the use of graphic primitives[7], a straight line or a curve are immediately drawn and admit no interference. To achieve the formative powers of traditional drawings, computer-generated drawings proceed in stages, forming almost an algorithm of signs, straight lines or curves.
In traditional survey, taking measurements involves procedures compatible with the representation methods used in restitution. Instead computer-based acquisitions follow a logic – and degree of accuracy – that has nothing to do with the requirements of the images or the results of architectural simulation: for example, 3D laser scanner acquisitions, restitution of discrete or continuous models, restitutions using

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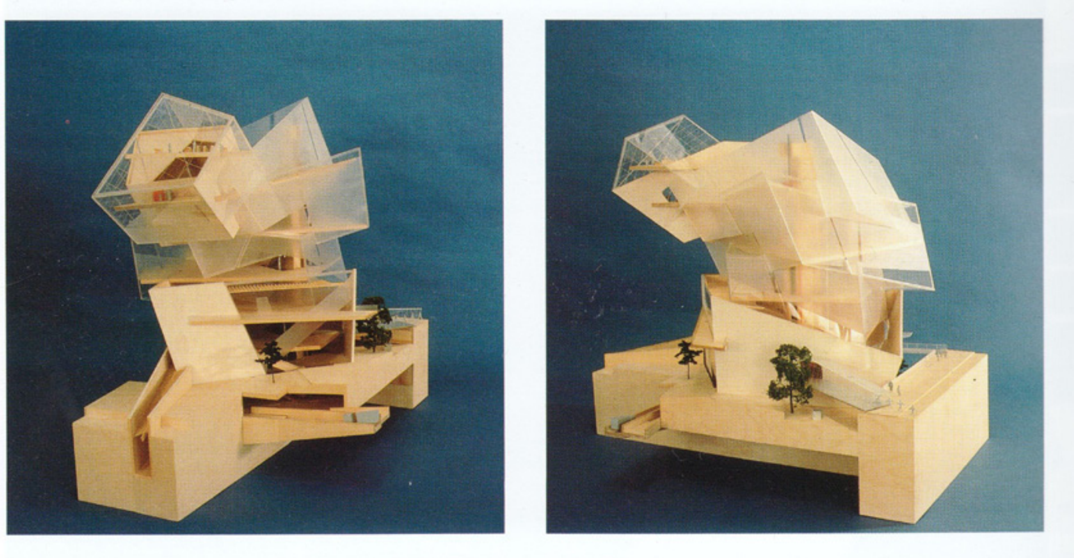

elevation lines or points, or contour lines.
Other issues include the tendency to be *realistic,* as well as the *scale factor*, *speed* and *memory* of the computer which functions using parameters that differ entirely to traditional parameters and are novel in the way they theorise and simulate results.
In short, what we're saying is that computers change the way we invent things because we no longer need to remember or use traditional methods to depict an order: we can violate all the age-old ways we used to create volumes and surfaces. Obviously, this is not a cause and effect kind of relationship, nor is it a fault in the machinery; we're only proposing it as a possibility based, or corroborated, by the options and accuracy provided by computers; almost as if the albeit unusual changes or study situations on which the computer encourages us to focus are dictated by a *desire* to find solutions regardless of their architectural quality.
Even if this is a simplified list of options and outcomes, it shows how the two representation systems (traditional and computer-generated) are extremely heterogeneous and to a certain extent incomparable: their logic and execution are different as are their scope and specific options. In short they can completely modify the attention and focus of users and, as a result, the way to find a solution.
Of course, whether and to what extent computer-generated representation and traditional representation are in contrast depends on the choices we make; but the differences remain and I believe it's wrong to portray computer-generated drawings simply as a modern version of traditional representation, or worse, an innocent multiplier of functions.
It's important to emphasise that these differences almost never influence the quality of the results, only the way we find and achieve them.
Rather than grade the two representation systems, from an educational point of view I believe it's more helpful to highlight the formative qualities of these two languages. Each user, with his own interests and sensibility, will hopefully find in these *procedural tools*[6] what he needs to influence research and its end products; these *procedural tools* coincide with what we previously called active factors of representation that influence not only the method, but also the results of one's work.
The logic of computer systems and their functions (e.g. mirroring, rotation, copying, extrusion) now plays an important role in the study procedure, a role that influences and almost self-determines an entire project (obviously, by themselves computers cannot invent drawings, but they can provide preferential methods to execute them).
Umberto Galimberti reminds us that "techniques work"[8], and the so-called active factors of representation, in other words, the procedural tools (or functions) of digital representation are – no doubt about it - remarkable opportunities that encourage the user to focus on completely novel problems or study issues: just think of the experimental designs and surveys produced in recent years.
The brilliant experiments by Daniel Libeskind, Zaha Hadid or Peter Eisenman, the first names to spring to mind, are based on this awareness. What I wish to emphasise here is the effects of these computer procedures on education and, as

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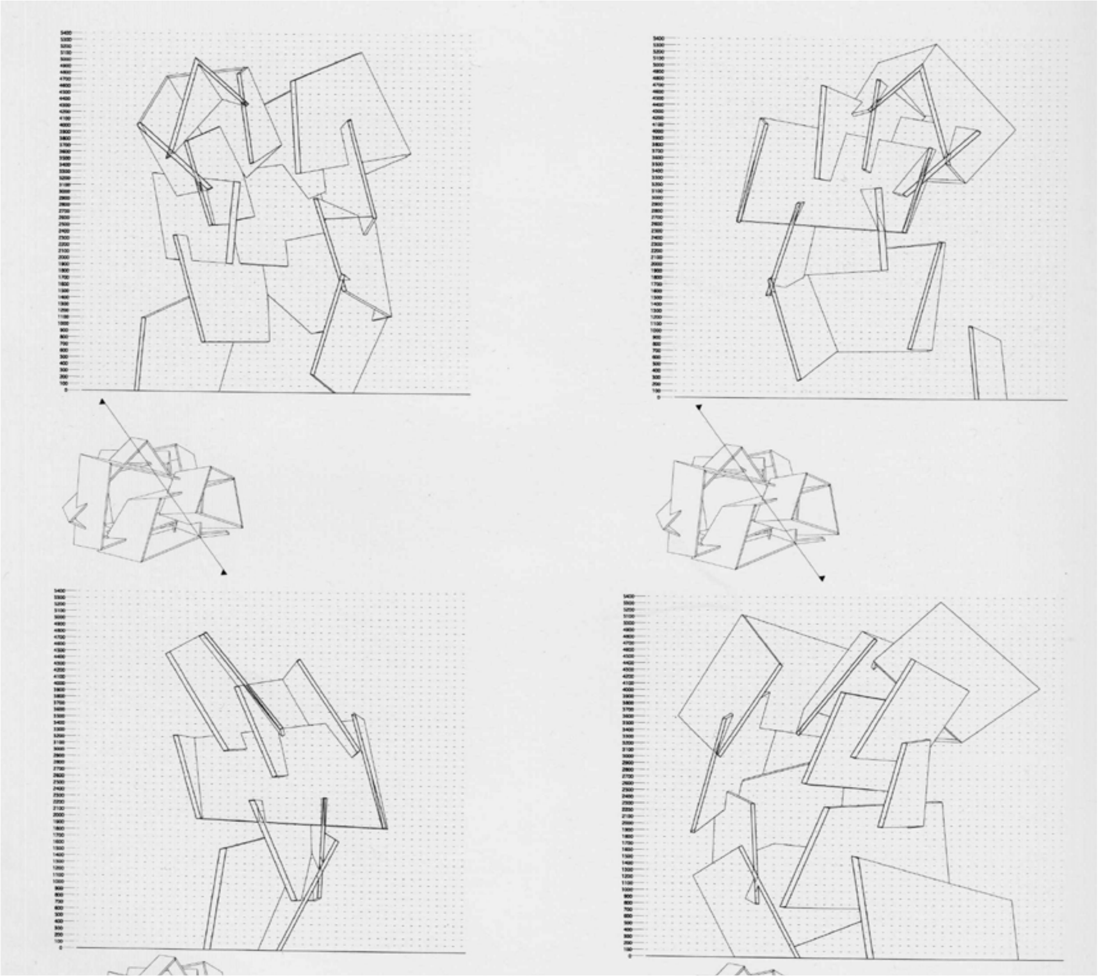

4-5/ Daniel Libeskind, extension of the Victoria & Albert Museum in London, 1996. After several models and axonometric projections drawn using a mainframe technique, Libeskind produces a series of computer-generated close-ups of the horizontal and vertical sections that tend to become a way to control the design.

a result, the considerations – or warnings – we need to highlight.
The works of the designers cited above show how they use non-traditional forms to express reality, but above all to find new solutions; they also highlight the research they used or, in other words, the *computer* options they exploited and how this *encouraged* them to experiment.
The extension of the Victoria & Albert Museum in London (1996), the Centre of Contemporary Arts in Rome (Maxxi, 1999) or the new Jubilee 2000 Church in Rome (1996) have aggregations and spaces based on changes to complex volumes which at the end of the design process are neither instantly recognisable nor do they have reference geometries.
We shouldn't forget that this kind of research often involves the use of traditional scale models during every formal design phase; the latter help to establish the measurements used in the drawings and to check on-site work:
- in the extension project for the Victoria & Albert Museum the planimetric solutions evolved into extremely unusual elevations; since there are no known interpretations, the juxtaposition

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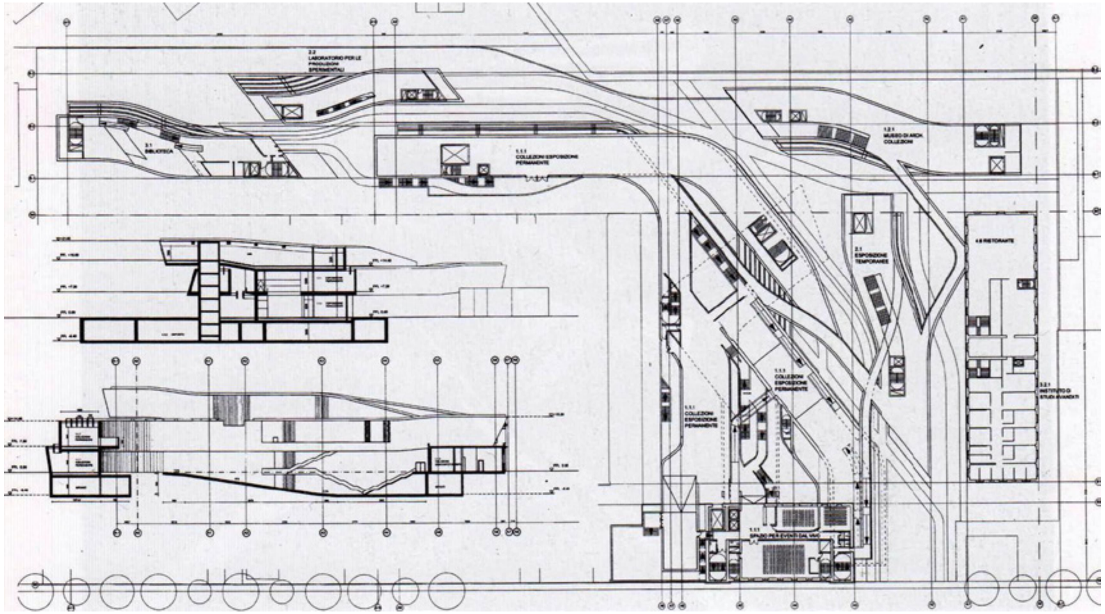

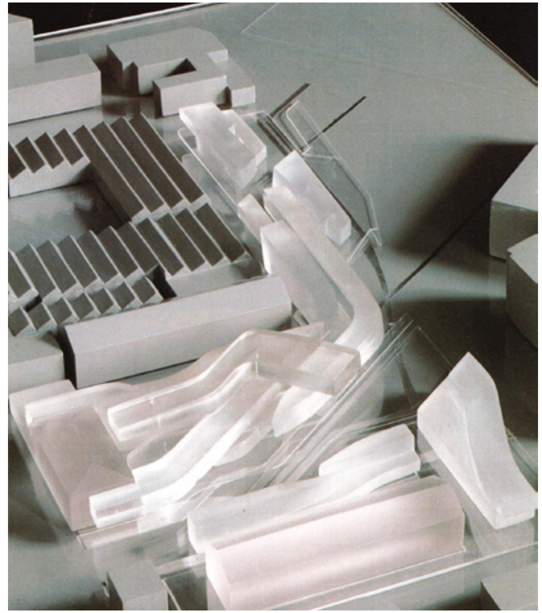

6-7/ Zaha Hadid, Centre for Contemporary Arts in Rome, 1999. Hadid uses all available tools to represent her design from, but from the end of the nineties the use of software – and its operational options - becomes crucial to check volumes and spaces.

and intersection of the volumes appear almost involuntary and devoid of any possible clarification.
The way the designs are arranged faithfully reflects this novel situation; after many models and several axonometric projections drawn using *mainframe* techniques, there is a *computer-generated sequence* of horizontal and vertical *sections* which tend to look like figurative devices used to control the design of the imagined forms (Figs. 4, 5).
- in her work Zaha Hadid uses the full range of available tools to represent her designs (traditional drawings, models and computers), but at the end of the nineties software became crucial to check the volumes and spaces of her designs. P. Schumacher wrote: “One of Zaha Hadid’s most audacious moves was to translate the dynamism and fluidity of her calligraphic hand directly into equally fluid tectonic systems”.[9]
In the design for the Centre of Contemporary Arts (Maxxi, 1999), the ideation process evolves from “two-dimensional splines later translated into three dimensions”.[10] The shift to the third dimension uses extrusions, oblique cuts, rotations, slippage, etc.… in other words it exploits the software’s potential and features (3D Studio Max). Here too, the sections are used both as study devices and to control forms (Figs. 6, 7).
- the church in Rome is further complicated by geometric volumes and oblique elevations; the ground floor plan covers a fourth or fifth of the overall shape, yet by itself cannot correctly portray the overall design. There is nothing we can compare it to in order to recognise the forms and, like the Maxxi, the designer uses the *sequence of sections* – and more in general the operational and descriptive possibilities of the plan – as the most suitable device with which to control its complexity and follow the basics of the design - even its most improbable aspects (Figs. 8, 9). A sequence of sections that tends to become an obligatory, so to speak *traditional,* recurrent figurative choice to verify the architectural designs created by digital representation.
It’s useful to remember that in the year 2000 even Peter Eisenman classified all his projects in a *diagram* or *grid*[11] to reflect on his work; he arranged the designs in chronological succession - *House I* (1967-68) at the top of the list and the IIT Student Center (1998) at the bottom. He listed all the traditional and digital tools he used, dividing them into *formal tools* and *conceptual tools*: the former refer to functions such as *extrusion,*

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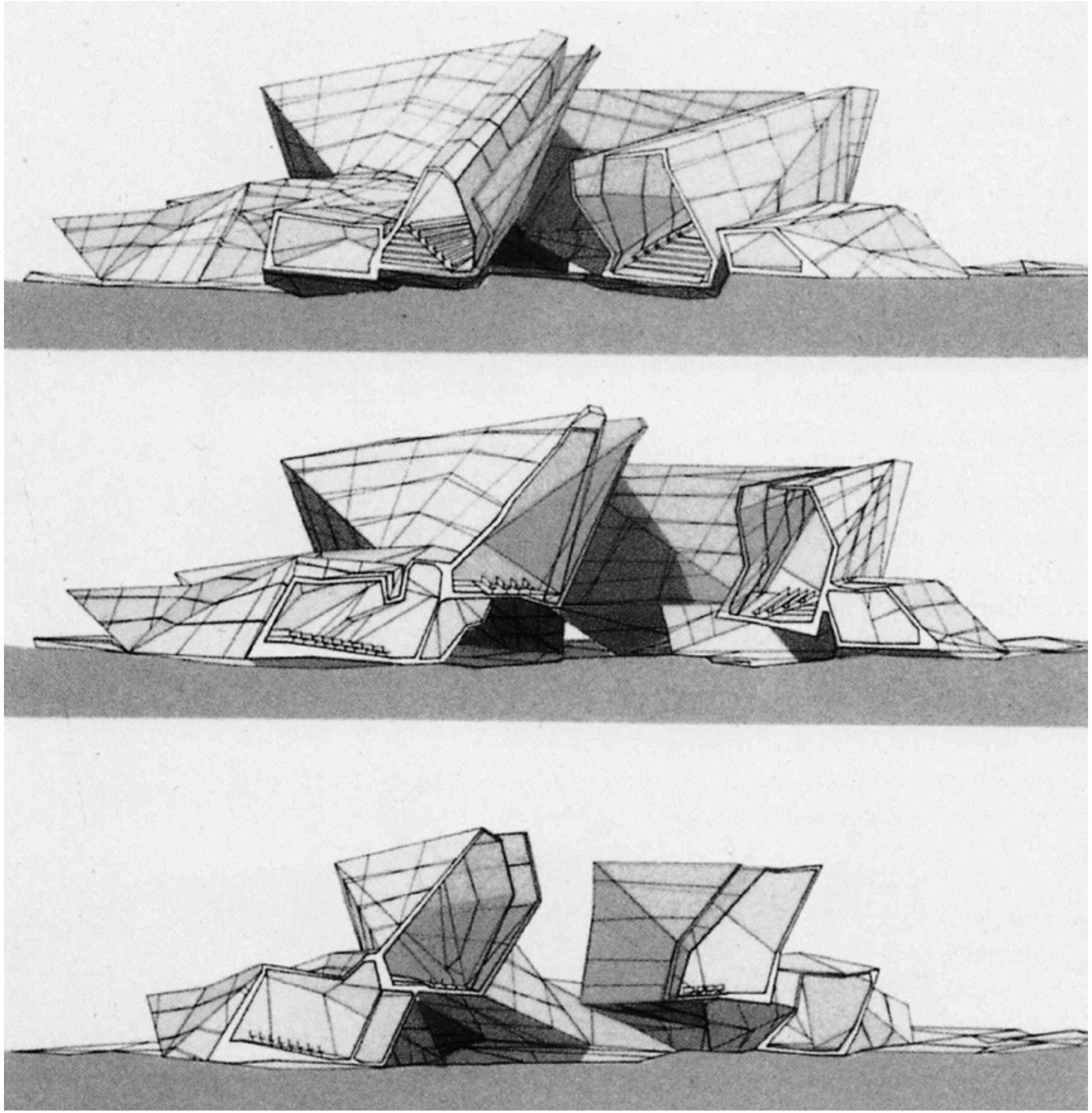

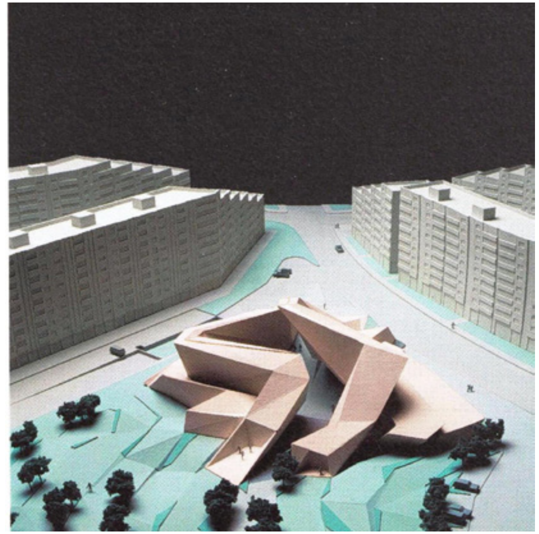

8-9/ Peter Eisenman, Jubilee 2000 Church in Rome, 1996. Like the Maxxi, the designer uses a close-up sequence of sections – and more in general the operational and descriptive possibilities of the plan – as the most suitable device with which to control its complexity and follow the basics of the design.

twisting, extension, morphing, distortion, scaling, rotation, slippage, etc.; the latter to the functions of *inversion, mapping, layering, montage, etc*.
In the diagram the connection between works and procedural tools clearly illustrates the relationships and importance he ascribes to the procedural tools and the different formal solutions they produce; it also shows how the forms evolved and the new design processes it inspired after the advent of *computers*.
From the nineties onwards, the results and research conducted by Eisenman change radically and it seems he cannot work without these new representation tools and the options they provide; at a certain point, Peter Eisenman appears to trust digital design – and the remarkable options it offers – to provide a successful end product. It's clear that without this digital tool, it would

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be difficult to achieve intersections and weaving (created by using the *intersection* function), interwoven forms (using *interweaving*), gradual or fluid transformations (using *morphing*) and the whole range of available design options; but above all they wouldn't capture and hold the attention of the designer.
In conclusion, from an educational point of view it's useful to remember that the importance of traditional or digital representation lies in its role as a language, in other words the chance to disarticulate and topicalise component parts and, more in general, the generative and study options of forms.
When trying to find an architectural solution, knowing and governing the rules – whether they refer to the image itself (schematic/similar, ensemble/detail, foreground/background) or to its geometry - is a sort of "legal" research tool that can help avoid producing illegible or totally unexpected figures. The same applies to how we consider plans (sections, elevations…) and their projective concepts, or geometric references – all useful to define surfaces and volumes. Even these become a sort of important legal research tool because they help not only to understand and define a concept, but can be used during the implementation phase of a project. Finally, it's important to recall all the possible representation tools available today; they give every designer the possibility to experiment and create his own style and, as a result, lay the groundwork for success.

NOTES

[1] The expression "active ingredients" was used for the first time in the Doctoral Dissertation by Luca Laino, Fattori attivi della rappresentazione informatica nel processo di formazione progettuale, Rome - La Sapienza, XX Cycle, tutor Giorgio Testa, in collaboration with Aldo De Sanctis.
[2] In Ackerman, James (2003), Architettura e Disegno- La rappresentazione da Vitruvio a Gehry, Milan Electa, pp. 29-30.
[3] These citations are taken from Raphael's famous letter to Pope Leo X (1517-'20), Leane Lefaivre, Alexander Tzonis, A documentary History, Routledge, New York, 2004, pp. 92-94
[4] These topics, already cited by the author in Giorgio Testa and Aldo De Sanctis, (2003), Rappresentazione e Architettura, Linguaggi per il rilievo ed il progetto, Rome,a Gangemi Editore, are further clarified and expanded on here.
[5] Marconi, Paolo (1979), Le Vedute di Roma, in AA. VV. "Piranesi nei luoghi di Piranesi", Roma Multigrafica Editrice, p.114.
[6] Procedural tools play the same role as the graphic devices used in traditional representation; obviously, even digital representation can use graphic devices, but often these appear automatically thanks to the functions of the software.
[7] In digital representation graphic primitives become a sort of neutral premise of the geometric form.
[8] Cfr. Galimberti, Umberto (2004), Psiche e Tecne - L'uomo nell'età della tecnica, Milan, Feltrinelli.
[9] Schumacher, Patrik (2004), Digital Hadid, landscapes in motion, Birkhauser, London.
[10] Schumacher, Patrik (2004), ibidem.
[11] Cfr. Eisenman, Peter (2000), Diagram diaries, New York, Universe Publishing.