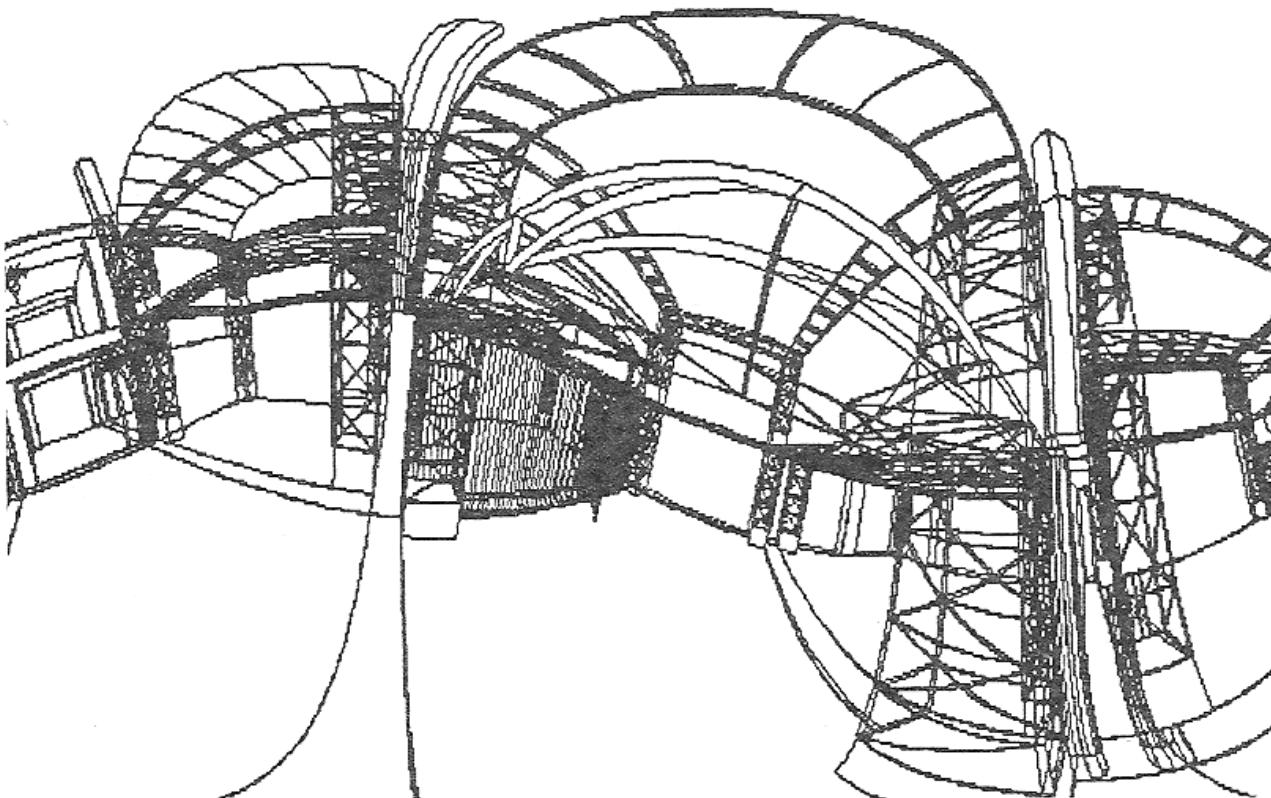


Celestino Soddu - Enrica Colabella

# ***GENERATIVE ART & DESIGN***

Theory, Methodology and Projects

Environmental Design of MORPHOGENESIS  
Genetic Codes of Artificial



DOMUS ARGENIA Pub.

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*Celestino Soddu - Enrica Colabella*

**GENERATIVE ART & DESIGN Theory, Methodology and Projects**

*Environmental Design of MORFOGENESIS. Genetic Codes of Artificial*

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## INTRODUCTION



*"My ego of now and my ego of soon are certainly to be two"*  
Montaigne, Papers

This book contains some considerations about designing. The design of the environment where we live. A natural/artificial system that each of us tries to forge by tracing a possible world model over the existing one, giving shape to our thoughts and desires.

Not a philosophy [1] of design but only reflections on traces of a path. The pursuit of one's own imagery, which develops with the randomness and unpredictability of subjective thought.

But with a peculiarity. These reflections are, never, only theoretical. Every hypothesis, every possible path that is proposed, every logical approach [2] to the project, to the environment, to the architecture, has been experimented operationally simulating it with original software. And this by using the most up-to-date and innovative mathematical tools, able to operate a direct and without preclusions approach to the complexity of reality, to the dynamics of unpredictable transformations, to morphogenesis, to random and possible, to chaos, to creativity as a temporal scan of evolution.

This research therefore proposes and is itself, an open conceptual system, using the secondary orality of the electronic communication [3] through procedures/software whose structural references go back in time to the primary orality of the world of Fabula.

This experimentation has allowed the subjective self, the contingent, and sometimes random human side to coexist with rational logic. Rather let this subjective unpredictability enter directly, through a specific algorithmic concretization, in the same operative logic.

With this, rediscovering, through the use of current technologies, the pleasure of pre-modern scientific speculation [4], not axiomatic but still linked to the observation and evaluation of the many and surprising facets of the contingent.

An unsuspected dynamic order has emerged, order as an unpredictable but recognizable way of slipping towards complexity, a time of the project that traces the character of infinite and possible parallel stories. But also an operative tool that redefines

in a controllable and contract-able context the possible contributions of the project to the total quality of the environment; simulating the always different, tortuous and fascinating stories of the discovery of the possible.

Is all this Artificial Intelligence? The approach is experimental [5]. Moreover, the work is carried out, essentially, on the specific discipline of the construction of the environment, of architecture, of the natural/artificial design and of the interface-object with man, rather than on the construction of general evaluations and positions.

This research can be considered as the construction of Artificial Intelligence, but only as simulations of human creativity. It is not a question of how intelligent these programs are. Perhaps, to quote Popper, they are just a sophisticated way of simulating intelligent behavior with logical sequences, with algorithms that are not intelligent. These simulation programs are a representation of the evolutionary dynamics of the idea, but they are not capable, in themselves, of ideation. Their contribution is, however, essential. Like all representations, they are irreplaceable access to knowledge. They tend to reproduce that world of resonances, multiple, light and imperceptible but capable of sudden reverberations, of overwhelming contaminations: the world of subjective creativity.

The secret complicity between the "metaphysical priority of unity over plurality and the contextualistic priority of plurality over unity", Habermas post-metaphysical thesis that "the unity of reason remains perceptible only in the plurality of its voices. [6]

The species projects, and the morphogenesis projects that trace the DNA of the artificial, propose a transcendental approach to the real/virtual through the rational construction of a subjective imaginary as a design idea/concept.

*Note 1. Paul K Feyerabend, Dialogues on knowledge, Saggittari Laterza 1991 (Italian ed.).*

*A. You mean the whole book is a joke?*

*B No, I'm serious -but not too serious- about a lot of things, but to summarise it in the form of a*

*<philosophical position> that's a joke. Many reviewers were attracted to the idea, though I left enough clues*

*Now, wait a minute! You say you've touched on things without.*

*B Yes.*

*A. However, you do not have a philosophical position.*

*B No. Perhaps you had something that resembled a philosophical < position > from student and the indium of my career. At the time I thought there was no knowledge other than scientific knowledge and that everything else was nonsense. This is a sort of < position >, isn't it?*

*A And then he became an anarchist.*

*B No. Then I read Wittgenstein."*

*Note 2. Ludwig Wittgenstein, "Tractatus logico philosophicus", (1918).*

*"Logic is not a doctrine, but a mirror image of the world."*

*Note 3. Walter J. Ong, "Interfaces of the Word", Il Mulino, 1989 (1977). Italian ed.*

*"Today, apparently, we live in a culture or cultures that are strongly oriented towards openness and*

*particular towards models of open conceptual representations. This opening can be connected with the*

*new type of orality that has emerged, the secondary orality of our electronic age, which together refers to and opposes primary orality, prior to writing.*

*Note 4. Stephen Toulmin, "Cosmopolis", Rizzoli 1991 Italian ed. (1990).*

*"...the lack of understanding between the sciences and the humanities... is a phenomenon that has beginning in the early seventeenth century, when Descartes persuaded his fellow philosophers to give up fields of study such as ethnography, history or poetry, both rich in content and contextually rich, and to focus on exclusively on abstract and decontextualized fields such as geometry, dynamics, and epistemology."*

*Note 5. Besides, also the always cited Turing's Evidence about the possible existence of Artificial Intelligence was nothing but a test to see experimentally if, questioning something that answers to our questions hidden in the next room, it was possible to recognize the computer from the man.*

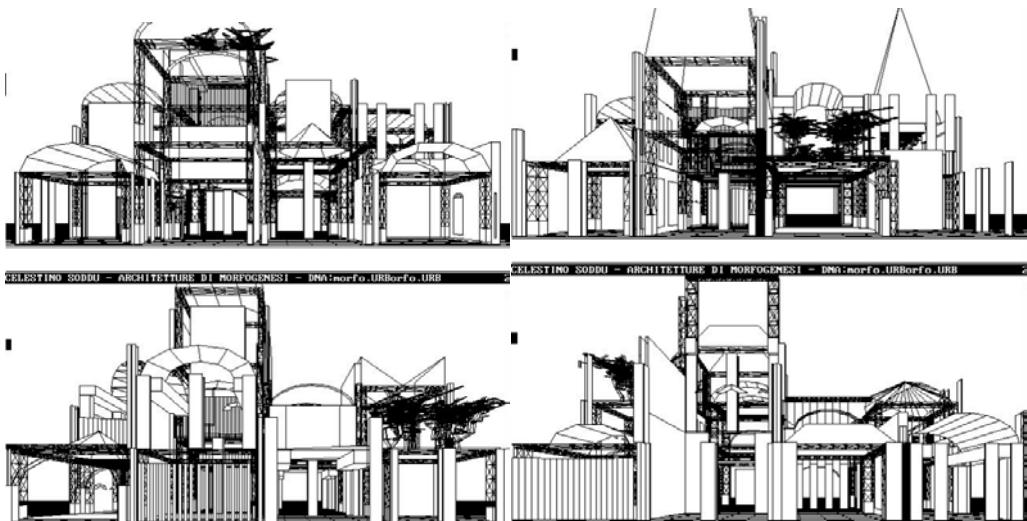
*Note 6. Jurgen Habermas, The post-metaphysical thought, Saggittari Laterza 1991 Italian ed. (1988)*

## **THE DESIGN OF MORPHOGENESIS**

The simulation of the evolution of form, the design of the Genetic Code in the environment, architecture and industrial design



*You talk to me about an invisible planetary system in which electrons gravitate around a nucleus,  
and you explain this with an image.  
I must admit, then, that you have arrived at poetry...  
A. Camus, Il Mito di Sisifo*



The language to which we are accustomed tends to be a sign of equality. The conventional rational approach rests its credibility on correspondence, the balance between word and phenomenon; and reflects the difficulty of being able to communicate and to control operationally, the changing world, the phenomena that evolve continuously. If we then want to consider the qualitative change, the morphogenesis of the transformation, the passage from the egg to the newborn, [1] the first objective we must set ourselves is to identify and use the appropriate instruments.

The problem has been addressed in theoretical mathematics and, in recent years, the results have been made operational through the use of electronic calculation tools. The result is a silent revolution that is certainly not only theoretical, but that is overturning, amplifying them, the same possibilities of knowing the reality that surrounds us.

Many other opportunities arise, in fact, by facing reality with tools that work directly on transformation.

At the base of these tools, of this language, there is the use of development procedures, that is, algorithms. Operationally this means not being tied to the sign of equality (for example  $A=B$  or  $A=124$ ) but being able to use a language that defines transformation and its time (for example  $A=A+1$ ). A notation, this one, which is paradoxical in terms of equality, balance, but which becomes obvious if we interpret it as the representation of a growing phenomenon ( $A$ ). Every time we use this algorithm, the event changes (in example  $A$  becomes bigger and bigger). And its transformation/growth is in relation to the time marked by this evolution [2]. (In our simple example it is marked by the iterative structure, by the number of times I use the algorithm itself, which becomes the temporal memory of the system to which it belongs).

Once discovered this possibility [3] to operate, it becomes necessary. The results that are obtained in the control/project of the environment, if a direct approach to non-equilibrium is used, are such as to make this passage non-reversible. In fact, it becomes immediately reductive and simplifying to continue to operate only and exclusively in reference to states of equilibrium.

As has been the case for some years now in the cognitive processes implemented in other disciplines, such as chemistry and physics, [4] we can work directly on the morphogenesis of natural and artificial forms. We can study the evolutionary dynamics of

the formal idea with unpredictable development systems that describe and simulate a specific design logic. And dynamically analyze the generation of the myriad forms that an environment, an architecture or an industrial object can assume while maintaining the recognizability of its functional, structural and above all compositional characteristics. Characters that we indicate, referring to Habermas, as post-metaphysical.

Our research, for a few years, aims in this direction and the experimental results have been very stimulating. We have carried out first operational experimentation by reconstructing on the computer the genetic code of particular urban images that reflect a compositional idea of cities. We have, for example, used the medieval city as one of these experimental occasions. Or rather what was born from our subjective compositional approach to Giotto's paintings, and to the urban space in transformation and evolution to which these paintings alluded.

In order to arrive at an acceptable [5] structural and image complexity, we had to experimentally simulate and retrace the dynamics of linear and non-linear development that this type of urban imagery presupposed, with the relative rules of the game, regimes of transition and contingent randomness.

In fact, we realized (building it as original software) the first experimental project of the evolutionary dynamics of the urban image. This project<sup>6</sup>, every time it was activated, produced virtually possible urban models, a series of three-dimensional models of cities whose shape was always unique and different from any other, but still identifiable by the morphogenetic characters typical of the evolutionary dynamics that had been designed, and that operated on a simulated time. In practice, every time the program/project was activated, a virtual story was re-traced, always different but parallel. As in the Fabula, the structure of the text slides with the subjective shifts of the story.

We thus realized that we had built a species project, very close to a natural genetic code as it was capable of producing an infinite series of unique individuals belonging to a species; a compositional/evolutionary species that translated the design modus operandi into a new plane. [7]

A first possible use of this tool was therefore defined in the possibility to propose, and control through simulation, the possible paths of development of the image of the city. An experimental tool, therefore, able to operate interactively on two variables that cannot be controlled in the usual design approaches to urban complexity: the evolutionary dynamics as the engine of transformation, and the image as a possible overall scenario due to the multiple choices that are made in the wide range of pertinence of the development of a complex system such as the city.

In these Species Projects the evolutionary dynamics, and therefore not only the expert but also the futuristic, is probed and controlled through a universe of possible scenarios [8]. These, even if they do not trace (because it is not possible since the environment is a dynamic system of unpredictable evolution) the univocal image of what the city will be like, they offer, however, through virtual models that can be computerized, the possibility to evaluate how the city will be configured if some (design) choices will be made. And this is represented through a universe of scenarios all different, but all characterizing the evolutionary system of the urban image.

The use of the "Project of Species" is precisely due to this relevance. To the possibility of interacting with the futuristic image, which is the variable that today is difficult to control in projects of planning and forecasting urban evolution. A variable that, on the other hand, arises as one of the central problems of the quality of life in the natural/artificial and metropolitan environment. The environmental image, shattered by the growing complexity of structures and services, must still be able to maintain, along with these transformations, its characterization, and recognizability. An identity that stands as indispensable to total quality which, in turn, must be constantly increased in

order to be preserved over time.

The possibility of representing, and therefore controlling in progress the evolution of a specific logic of environmental development (the design/operational methods, the devices programmed to achieve the set objectives) offers a viable and effective channel to evaluate, within the same design process, the environmental quality as a dynamic variable between virtual and possible. This evaluation is carried out through the simulation of evolutionary scenarios that make explicit the variation of the characters of recognizability, even in the face of design choices on fields not directly related to the form. This makes the image and its quality contractable, even if these evaluations do not take place by operating within linear structures request/response, but by comparing the futuristic scenarios related to the desirable collective imagination.

The following experimentation was to verify and use this theoretical/instrumental approach, the Project of Species, directly on compositional occasions that operate on multiplicity. Within the current request [9] to realize not identical repeated objects, but a varied series, different but identifiable individuals as belonging to a species, recognizable by their compositional characterization.

In the industrial object, in fact, the Design of Morphogenesis (as we have called the Project of Species when the objective to be pursued is the genetic code of the artificial in view of a production of unique individuals) expresses all its potential, responding to the needs of varied series, customization, sensitivity to differences, heterotopias that are typical of contemporary times.

The Design of Morphogenesis, [10] therefore, operating directly with choices that involve the way the form is developed and not the contingent aspects of one of the possible outcomes, becomes the project of the genetic code of a kind of object, a project that operates by choosing upstream of the single final result and that proposes, even in the industrial object, the aura of uniqueness and unrepeatability of the artistic object, the uniqueness, and unrepeatability of the natural individual.

*Note 1. Gunnar Olsson, "Lines without shadows", Theoria 1991, draws a possible picture of the tools to be used to control the evolutionary dynamics of events:*

*"In conventional reasoning, the anchor of identity reflects the principle that the same classifying word must always refer to exactly the same phenomenon. ... There are many problems with this interpretation of the sign of equality. The most urgent is that it makes it very difficult to apply it to qualitative change, that is, to the capture of the relations between phenomena that change abruptly, such as those between the fertilized egg and the newborn. To handle similar cases it seems necessary to move towards another definition, in which the meaning of words can change in the company of the phenomenon they denote. Such a way of reasoning would not be anchored to the immutable meaning of the words label, but on the contrary to the evolving relationships of the things to which the words refer".*

*Fig. 1/2/3/4. Scenarios of virtual architectures, different but belonging to the same species, generated by the morphogenesis project "Terme", designed by C. Soddu.*

*Note 2. Gregoire Nicolis Ilya Prigogine, "The birth of time" Theoria 1988*

*"We must re-examine the meaning of the second principle of the dynamic: instead of a negative principle, of destruction, we see another conception of time emerge. Classical physics had produced only two notions of time: Einstein's illusion of time, and the time-degradation of entropy. But these two times do not apply to today's situation. In its first moments the universe, still very small and very hot, was a*

*universe in equilibrium. Now it's turned into a universe of non-equilibrium... The evolution of the universe has not been in the direction of degradation but of increasing complexity, with structures appearing progressively at every level, from stars and galaxies to biological systems."*

*Note 3. Gregoire Nicolis Ilya Prigogine, "The birth of time" Theoria 1988  
"Non-equilibrium is the domain par excellence of the multiplicity of solutions... There is no more explosive field, today than the study of the phenomena of non-equilibrium.*

*Because today we know that many of the interesting phenomena observed in the laboratory, and which play a fundamental role in the world around us, are not comprehensible except by taking on the non-equilibrium".*

*Note 4. Gregoire Nicolis Ilya Prigogine, "The Complexity", Einaudi 1991 (1987)  
In the preface, in reference to the changes in contemporary research that have opened new horizons for scientific discovery:*

*"Two disciplines, in particular, seem to us to have played an essential role in the dramatic change in our view of complexity: the first is the physics of non-equilibrium, whose most unexpected results have come from the discovery of new fundamental properties of matter in conditions far from equilibrium; the second is the modern theory of dynamic systems, whose central discovery is the prevalence of instability, i.e. the fact that small changes in initial conditions can lead to great amplification of the final effects".*

*Note 5. The genetic code used reflects the same structure of the natural DNA, being formed by a series of algorithms that tell linear systems of development dedicated to the single modes of development of reality, but whose simultaneous structure (the propellers wrapped in the natural DNA) generating "resonance" produce complexity and unpredictability of evolution, and a quantity of "information" extremely higher than what the same genetic code could contain if the structure were not a dynamic system with unpredictable development but told "explicitly", one by one, all the single events that can be generated. (but this is discussed more extensively in the following chapters).*

*Note 6. Celestino Soddu, "Città Aleatorie", Masson Ed. 1989, "Unpredicatable Cities" English version 2020.*

*Note 7 Jurgen Habermas, Il pensiero post metafisico, Saggittari Laterza 1991 Italian ed. (1988).*

*"Metaphysics has at its disposal the concepts of species and specific difference to break down the Universal into the Particular. According to the genealogical model, the tree of ideas and concepts of species ramifies at each level of generality into specific differences, from which each species can again constitute a genius loci for further determinations... the individual remains graspable only in the accidental peel that inerts as something external and random to the core of the entity determined according to the genus and species".*

*Note 8. This is not only for the design concept. As described below, it is possible to enliven, translate into the processes of natural transformation the virtual world of the already represented, the objects of art. We can, for example, work morphogenetically*

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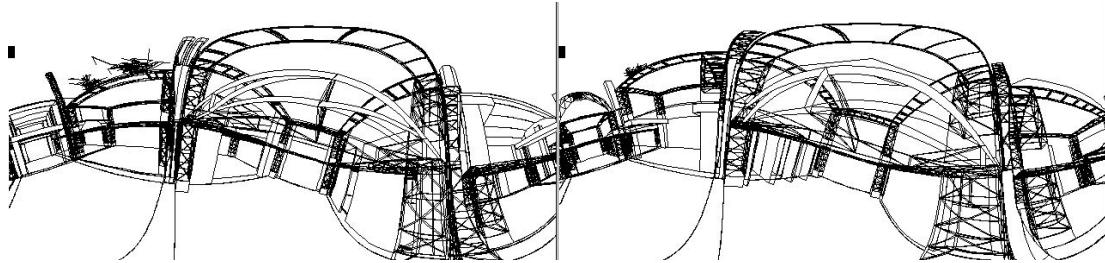
*on paintings by Kandinskij or Klee and generate infinite transformations while maintaining recognizable identities.*

*Note 9. Gilles Deleuze, 'La Piega', Einaudi Ed. 1990 Italian ed. (1988)  
The object is no longer defined with an essential shape but reaches a pure functionality in declining a family of curves identified by parameters, inseparable from a series of possible declinations or from a surface with variable cubage, described by the object itself.*

*Note 10. Celestino Soddu, 'The simulation of the evolutionary dynamics of the shape. From possible metropolitan scenarios to Morphogenetic Design, Proceedings of the Interactive City Conference, Politecnico di Milano 1991.*

*"Design of Morphogenesis. Le sedie virtuali", Interview with Celestino Soddu, Modo Magazine n 132, 1991.*

## COMPLEXITY AND EVOLUTIONARY DYNAMICS



*I see you again  
City of my frightfully lost childhood...  
Sad and cheerful city, here I am again dreaming... Me? But I'm the same  
one who lived here, who came back here, and who came back here, and  
came back to find  
and come back again? Or are we all the I's who have been and have been a  
series of pearls-entities bound by a thread, a series of dreams of me of  
someone outside of me?  
F. Pessoa, Only one multitude, vol. 1*

It is extremely difficult to define complexity as a static attribute of an event [1], of an environment. Complexity is, first of all, not only the result but the very form of an evolutionary dynamic. It depends, essentially and solely, on how the system/object/environment we are considering has evolved.

It is, in fact, impossible, and unthinkable, to produce complexity directly, extemporaneously, without activating and waiting for the evolution of a dynamic process. A process of accumulation of successive returns and possible re-readings and, at the same time, of progressive selection.

The complexity, whether we refer to a historically stratified city, a natural environment, an architecture or an industrial object, derives from the history, real or virtual, that has been traversed in the project, and/or evolution. A history in which the image, through the linear and discontinuous evolution that it has gone through, has increased, and not shattered, its characterization and recognizability, has forged the specific uniqueness of the event.

If, as designers, we try to imagine ex-novo, and to design extemporaneously a city that has the character of an environment with complex historical stratifications, we are going to meet a sure failure. If we are not Piranesi [2], with the ability to live simultaneously a plurality of possible virtual stories, each one capable of leaving traces and shapes that progressively accumulate and evolve in drawing, we would probably

produce reductive and simplified drawings. Or, simply, complicated. If they are not born retracing the possible evolution of form, they will never reflect the complexity of the environment.

Complexity is linked to the dynamic process of transformation. It arises from this process. But if a dynamic process of development is necessary to produce complexity, this is not, however, sufficient. Something more is needed.

For the complexity of the artificial to happen, the evolutionary process must not only take place but in its evolution it must go through moments of transition between different regimes, reproducing with this virtual experience the bipolar learning/evolution structure of the natural. [3]

This is because two types of growth are necessary: the accumulation of events and references (due to the process), and the formation of recognizability, due to the growth of the capacity of continuous self-organization of the system in the face of what changes, even abruptly. [4]

A city, for example, acquires complexity not only from the length of time lived, but also, from having gone through different historical and cultural moments, conceptually different and contradictory development programs, and from the ability to live simultaneously these facets of the possible. and above all,

But that's not all. Complexity is also manifested by the ability to place oneself (we could say also to react) in front of these events. An ability to satisfy unforeseen and previously unpredictable demands, where the quality of objects is not static but in the process of becoming<sup>5</sup>. This ability is an attribute that we can identify and define as a potential for self-organization of the system, once it finds itself within a changing environment. In order to keep intact, indeed to increase, its recognizability and characterization.

In this sense, if we want to give an example, Rome, understood as a historical center, is certainly much more complex than any other city. And its complexity is directly related to having been able to maintain, indeed increase, its individuality and characterization through different and discontinuous historical and cultural moments.

In architectural or design projects the theoretical approach to complexity is twofold. Take for example the Vespa. It is an object that has been produced, according to increasingly technologically and formally advanced versions, for thirty years. Certainly, it has acquired complexity, but this evaluation cannot only refer to the length of its production history.

There is also a more stringent reference. It is the specific history of the project that has taken place, the evolution from the first idea to the final result, the ability of this idea to grow through jumps, discontinuity, and modification.

Complexity also depends, and in a more pertinent way if one evaluates it on the scale of the object, on the design history that led to that possible architecture, to the genius loci of a given environment, to that particular industrial product. And above all from how the project evolved, from the operative logic that was activated, and not only from the extemporary gesture that could catalyze, trigger the evolutionary process.

*Note 1. Gregoire Nicolis Ilya Prigogine, "The complexity", Einaudi 1991 (1987)*

*"...it is more natural, or less ambiguous, to speak of complex behavior rather than complex systems. The study of such behavior will reveal a number of characteristics common to different classes of systems and will allow us to arrive at a proper understanding of complexity.*

*Figures 1/2/3/4. Some three-dimensional models, virtual scenarios generated by the*

*TERME species project. This species project is a software able to generate virtual spaces always different but all characterized by the same compositional logic. In the images, the models are represented in a total 360-degree perspective, seen by an observer inside the represented space, and with an inclination of the optical axis with respect to the horizontal plane.*

*Note 2. Manfredo Tafuri, "La sfera e il labirinto", Einaudi 1980. On the subject of Piranesi, a wicked architect": "The crushing of organisms, the violence on the laws of perspective, the intuition of the possibilities offered by an indefinite opening of form - the continuous metamorphosis of spaces, in the Prisons, ... mark, without the possibility of misunderstanding, the end of the Albertian precepts of concinnity and finitio. ... The "impure" forms of Romans are such because they are compromised with the dimension of temporal-visited space, eroded, indeed, by time, compromised with existence, with everyday life".*

*Note 3. Gregory Bateson, "Intelligence, experience, evolution", lecture at the Camazone Inst. Boulder, 1980*

*"... a world essentially double in its structure, in which at a level of organization, I don't say simple but inferior, there is something called learning, and at a higher level, there is something called evolution... it's like a game because a game essentially takes place between two levels of Gestalt, two levels of configuration, and when they crush each other, we cry or laugh or pray to God or religion or whatever, or we become schizophrenic. What to do then? There are no things to do. There are movements..."*

*Note 4. G. N. Ilya Prigogine, "The Complexity", Einaudi 1991 (1987)*

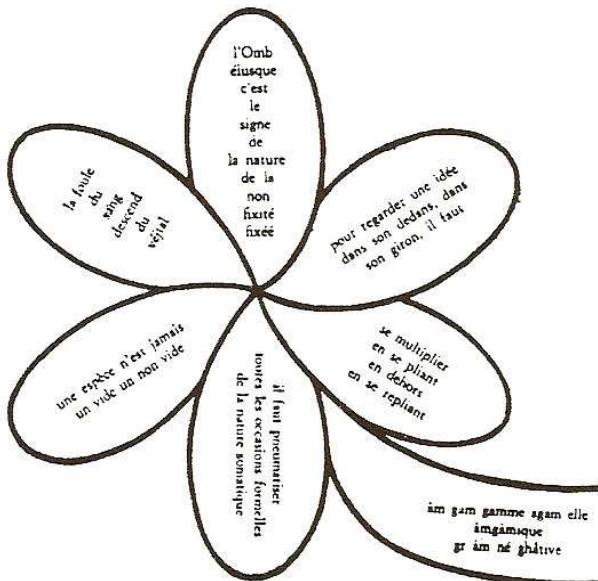
*"We see that far from balance ... the system adapts to its surroundings in many different ways, or to be less anthropomorphic, we say that more solutions are possible for the same parametric values. Only a chance will decide which of these solutions will be realized. The fact that among many choices only one will be realized gives the system a historical dimension, a sort of memory of a past event that took place in a critical moment and that will affect its further evolution".*

*Note 5. Rudolf Arnheim "The dynamics of the architectural form", Feltrinelli 1981 (1977)*

*"Verbal language has accustomed us to think of the properties of objects as accessories, that is, as things attached to things. However, as soon as we consider these properties from a dynamic point of view, we realize that they belong not to things but to activities, and are therefore adverbial rather than adjectival".*

## **COMPLEXITY AND DESIGN**

### ***the use of models***



*E. Villa, L'homme qui descend quelque:  
 roman métamytique*

If the quality of a project depends, even if only partially, on the complexity that is achieved, it becomes necessary to operate in such a way as to dominate, and control, its growth. Especially when, by starting the project, we trigger an evolutionary process of the idea with a specific and characterizing development dynamic.

This operation is not entirely simple if we also intend to face, and dominate the project, the transitions between different moments, between different successive hypotheses. These represent, in development, precisely the changes of regime, of paradigm, the evolutionary moments in which complexity is generated. And in which we work directly on the growth of the characterizing image, on the formation of the compositional recognizability of the same project. In other words, on quality [1].

How does a project develop? We abandon the path based on the uniqueness of the creative gesture as a peremptory affirmation of the architectural sign, to follow an open process. To reach the intersubjectivity through multiple verifications, of the high quantitative thickness of the design idea. The operative attitude at the basis of this approach is to produce a model and compare it with the requests.

It is an attitude that derives directly (and necessarily, since both are operational attitudes working in the field of "discovery") from the typical approach of scientific research: the procedure described by Thomas Khun [2] for scientific research. It remains

today the reference point for a non-analytical approach such as the design approach. It is working by successive circumstantial paradigms and by moments of continuity (normal) and discontinuity (exceptional).

Already this way of facing design presents operational difficulties for those who are accustomed to facing problems by analyzing what the client asks for and "responding in tone", i.e. assuming they can deduce the answer from the requests. But it is unthinkable to deduce the formal choices from the requests of the project, also because the formalized answers operate, and orient, a field of much greater relevance than the requests themselves.

To design we must, without being able to deduce it from anything, produce a model. Without being able to deduce it from anything, it can generate a sense of emptiness, of uncertainty. In reality, this model is a summa among our desires for real-world objects imbued with a strong emotional and passionate subjectivity amalgamated in the depths of our dream world.

Then we verify if, and how, this model responds to the requests and produces evolution, re-proposing the formalized answers as further unforeseen questions. Finally, we evaluate the opportunity to continue this cyclical proliferation of requests and forms.

The design then follows a formalized-response/request cycle as each formalized response becomes a request (at a more sophisticated level) in the next cycle. All this proliferation of events/requests must find space within the product model. The structure of the evolution that we trigger with the project gives us some indications that we must respect in the (preventive) formulation of the model.

The basic indication is peremptory: we must produce a model in advance that will have to be able to respond to requests that are not yet known.

What we already know, and that we can identify with the basic requests of the project (those, to be clear, that could come from the client) is in fact only a small part of what we will actually have to take into consideration, and that will arise from the evolution of the project itself.

And again. All these requests considered (the basic ones and the subsequent design ones) are only a part of those that the architecture or the industrial object once realized will have to satisfy. The increase is due to the fact that the context changes. The reference environment evolves its image and identity, the use and the user changes, the entire cultural, historical and functional context evolves along unpredictable and unexpected lines. Instability is the soul of the process.

But, despite these transformations, the designed object will have to maintain a capacity of response, no matter if for a few minutes or for centuries. It must be usable in a context and for uses that are absolutely unpredictable and functionally identifiable in an exhaustive way.

The Pantheon, for example, two thousand years after its creation, still has a strong relevance as architecture and environment (a functional relevance in the broad sense, and therefore still structurally capable, like contemporary objects, of activating practical, aesthetic and symbolic functions responding to our needs). This regardless of its dating and importance as historical and cultural memory. Which parameters should we consider when we produce a model, and which evaluation or control mode should we activate in order to govern, in its becoming design, the possible evolutions towards complexity?

As is discussed more extensively in the following chapters, the circumstantial model/paradigm that we build in order to control the project, and which allows us to proceed linearly along with the "normal development", must have two classes of requirements. It can and must, first of all, be an explicitation of our subjective conceptual need for architecture, and then reflect our cultural/subjective/humoral/casual/contingent background.

Precisely this charge of subjectivity, and therefore of lability/variability along the time of the project (every designer, as a human being, can change his or her mind, or simply mood, during the project, or something random and unforeseen can happen that affects the type of approach) will be a winning card in the challenge to complexity as the ability of multiple, unpredictable and intersubjective responses. That is, towards a growth/accumulation of possible meanings/responses, therefore towards an "open" form.

The second field of evaluation of every circumstantial paradigm we adopt must be that of adaptability. The paradigm must have an extremely high willingness to grow and change. This may also mean that this model should not tend to be structurally characterized according to the plan of contingent functions. These in fact, due to their highly practical character, can generate a categorical and axiomatic model, therefore not very willing to survive environmental/cultural changes and the subjectivity and unpredictability of the requests to which the project will have to respond.

A more appropriate reference for the construction of the paradigm can be the plane of symbolic forms/functions [3] which can then be filled, whenever the reference context changes, with contingent contents. And this maintaining, however, despite these variations, a recognizable autonomous capacity of characterization. These choices built on the symbolic plane, in fact, do not compress the adaptability of the model. This cannot deny the model's ability to produce pertinent responses to basic functional demands. Quite the contrary. This only means that the form [4] of the model must not derive (deductively or inductively) from specific contingent requests, but must only include them. The ability to respond to individual requests becomes a necessary, obvious, but not structuring attribute.

In other words, and to the limit, any doodle could be fine as a first paradigm towards complexity, as long as the possible forms to which it alludes are comprehensible with respect to the theme and cultured. What is asked of this design is, in fact, to be stimulating for the designer himself, and extremely willing to evolve, that is, to acquire and understand complexity.

It must not be a categorical gesture. It must not be a categorical gesture. It must be a chilling gesture for any other possible further development, any possible growth of complexity.

The use that will be made of this model for design is the classic one operated in scientific research: a logical trace of management of the dynamic flow of random and contingent.

Every subsequent design occasion is compared with the model. And the occasions are the discovery, very often unexpected or random, of new requests to be satisfied through subsequent formalization operations. The personal design ability is strongly based on the attention to see and discover, first of all, and then to cultivate and not underestimate the potential requests/occasions that arise from the very evolution of the project.

The specificity and pertinence of each choice (caught on the fly in the flow of the contingency, and operated) are lowered into the model, structured and evaluated in the light of this reference framework that, as a context, redefines its meaning and ability to respond. If the choice is accepted, this further contribution of formalization is translated into the same model adopted.

Does this increase its complexity? Really this is the way the project uses to increase its complexity?

Only partially. And only for that much evolution, the transition from one way of being to another, that every single choice adopted can bring to the model used.

The real growth of complexity of the project is a function of the acquisition of the capacity of self-organization [5] continues: the capacity that the model acquires in its making/transforming, of virtually changing behavior modes as contingent conditions

change. This means, in practice, that even if we suddenly change the point of view, reading code, mood, the project will be able to virtually actively adapt to change [6], not losing its ability to fascinate, to pertinently satisfy our sudden, unpredictable subjective demands.

But the acquisition of this capacity of self-organization involves, as will be specified later, the need to replace several times, along the design road, one model with another. And it also derives from having respected a fundamental rule of evolution: each new model/paradigm adopted must be more available and open than the previous one, and capable of simultaneously answering (and remembering!) all the previous questions that the previous model was able to satisfy.

We, therefore, assume that the increase in complexity in a system (natural/artificial environment, evolving city, evolving architecture or evolving design object) also corresponds to an increase in response capacity, therefore flexibility and adaptability.

If this is acceptable, the possibility arises of evaluating, every time we make a choice, whether or not we are approaching the set objective.

Each choice [7], if we consider it as a further step towards complexity, crosses three8 distinct fields of pertinence: one related to performance requests on contingent functional needs, one that concerns randomness and subjectivity, the last one that tends to increase the formation of the order.

Each of these three plans is necessary to increase the complexity of the project. This is well known to the designer who, every time he makes a choice of formalization, having to operate on all three fields, makes up for the possible lack of a specific request on one of these fields. If, for example, a specific growth phase of the project requires, in the designer's evaluation, a choice of formalization that brings order and increase subjectivity/casuality, and the contingent functional request does not exist, the latter is artificially generated ad hoc.

And conversely, when it is necessary to satisfy a contingent performance request, the response that the designer structures and formalizes transcend the specific. It is, in any case, an incident on the overall order and produces additional responses in reference to the designer's imagination and conceptual needs.

Let's analyze, in more detail, the specific contribution of these three fields to the growth of complexity.

What concerns requests for services is the most obvious. It is clear that any increase in response capacity increases the complexity of the architecture itself. But, surprisingly, it is also the weakest, most labile field. The field of practical functional demands is, in fact, the last incident in accelerating the evolutionary dynamics of the project (the practical functions increase relatively little, during the design, to a greater extent the aesthetic and symbolic functions that, however, relate more specifically to the other plans). The complex of practical functional performance is also the field most subject to deterioration and obsolescence in the life of architecture, once built. [9]

The field of randomness/subjectivity is, on the contrary, the most active. The margins of randomness inherent in each choice operate directly as a propellant in the evolutionary dynamics of the project, and therefore in the increase of complexity.

Randomness, also in its humoral form of response to subjective contingency, is in fact necessarily present in every choice [10] and acts, in fact, as a short-range catalyst in the progressive accumulation of meaning, in the development of the project.

Its role as a catalyst is to increase the contingent capacity of evolution without necessarily being an element in itself capable of directly affecting the final result.

As such, randomness/subjectivity is indispensable. Each random contribution is an innovative element to explore the possibilities.

This random/subjective component not only always produces new demands, but

also tests the flexibility and adaptability of the model adopted, and therefore its intrinsic reliability.

The random component also operates on another level, equally essential to complexity, as it alludes to the interchangeability of possible forms, different but equally relevant to individual moments of choice.

If upstream of this proliferation of possible multiple formalizations, we recognize or even glimpse, an identity of the project, this leads us back to the specificity of the compositional logic adopted. If this happens, the project itself is acquiring depth and complexity, and with the project, we are also refining the identity and recognizability of our specific design making.

The hypothesis (which will be developed later) is that contingent forms can qualify the single project. While the identity and characterization that goes beyond these contingent forms, the species that includes but does not identify and homologate the individuals/events designed, is the compositional matrix of the designer. [11]

The third field of the pertinence of the design choices, order formation, operates instead at a long-range.

The objective to be achieved is to keep the design engine running and running. The order must not be, that is, the consolidation of a balance, of a static organization but, on the contrary, the adaptation and continuous evolution of the capabilities of the adopted model. In order to maintain the response capacity of the chosen system intact, and when fully operational, the evolutionary charge of the design challenge that has been undertaken.

On the other hand, as happens in nature when jumps towards complexity occur, the long-range interaction between single units exists only if the system is evolving. In a static system the interaction between single units, therefore the increase in order, cannot go beyond the connections and exchanges between neighboring units. [12]

All these factors, at the same time, guarantee that the process of increasing complexity can proceed. But this is not enough. One of the essential requirements for this process of increasing complexity to take place is related to the presence of a particular type of evolutionary dynamic. In order to structure and consolidate the capacity of self-organization, it is necessary that the process is not always linear, but crosses a series of discontinuities, passing from one paradigm of reference to another.

In other words, the development must present structural bifurcations concerning the same organization of the project, and every possible evolution, even if it can be arbitrarily optioned because it is interchangeable at the moment of the choice, will become, once made, irreversibly characterizing the single project.

In terms of growth of complexity, the passage from one paradigm of reference to another (as it happens at every bifurcation of the non-linear process), favors the persistence of choices capable of simultaneously answering a plurality of questions, while it accelerates the elimination of the rubbish of categoricity, of the choices that are consumed in the brief turn of a hypothesis, of the events that, after their contingent (but indispensable) role as catalysts of the process, must be promptly removed.

The accumulation of meaning that the progressive shift from one context/paradigm to another generates is, already in itself, complexity. As it not only proposes multiple stratifications of simultaneous readings of the overall event but, through the evolutionary selection described above, acquires the ability to respond to always different contexts, while simultaneously proceeding to an increase in characterization. It, therefore, acquires the capacity of self-organization that guarantees that the environment, architecture, and industrial object can presumably respond to subjectivity, cultures, and unpredictable future contexts. In other words, they know how to respond to their specifics: to the multiple, simultaneous and changing needs of human life beyond its borders, contexts,

and cultures.

*Note 1. Renè Thom, "Structural stability and morphogenesis", Einaudi 1980  
"We can, therefore, ask ourselves whether, with a refinement of our geometric intuition, we can not endow the scientific spirit with a complex of more refined images and patterns that can give satisfactory qualitative representations of partial phenomena. Indeed, one thing must be convinced: following recent advances in topology and differential analysis, it is now possible to access rigorous qualitative thinking".*

*Note 2. Thomas S. Kuhn, "The structure of scientific revolutions", Einaudi 1969.*

*Note 3. The reference is to Ernst Cassirer, "Philosophy of symbolic forms", where the symbolic form is identified as "all-inclusive medium" capable of structuring a multiple and simultaneous response to different subjectivities/spiritualities.*

*Note 4. Rudolf Arnheim, "The dynamics of the architectural form", Feltrinelli 1981 (1977)*

*"William James, in his Principles of Psychology, quotes "the old French saying la function fait l'organe", and we know how architects have applied this biological principle to their work. It's just. It is clear that neither in biology nor in the applied arts can form ever be entirely determined by the function. The reason explained it very clearly by designer David Pye and is that the function consists of abstract principles, not forms. For example, the function that can be performed by a wedge is describable verbally. The principle designates a range of configurations suitable for the purpose, but does not indicate any preference for this or that particular achievement"*

*Note 5. Ilya Prigogine, Op.cit.*

*Note 6. Andries van Onck, "Metadesign", in Modern Construction No 85, 1965  
"We ask that a design possess the characteristic of homeostasis (a term created by the physiologist W.B.Cannon) that is the ability to maintain an organic balance despite disturbances in the environment. Homeostasis is implied by meta-design".*

*Note 7. An indication of the relevant fields related to the choices can be found in Gregoire Nicolis Ilya Prigogine, "The complexity", Einaudi 1991 (1987)  
"complexity" is related to the ability to change between different modes of behavior as the conditions of the surrounding environment change. Flexibility and adaptability of the results introduce, in turn, the notion of choice among the vain possibilities offered. It was stressed that the choice is mediated by the dynamics of fluctuations and requires the intervention of their two antagonistic manifestations: short-range randomness' which provides the 'innovative' element necessary to explore the space*

*of states; and long-range order' which enables the system to maintain a collective regime that includes macroscopic spatial regions and macroscopic time intervals".*

*Note 8. F. Pessoa, "I1 book of disquiet", Feltrinelli*

*"The environment is the soul of things, everything has its own expression and that expression comes from outside. Everything is the intersection of three lines, and those three lines form that thing: a certain amount' of matter, the way we interpret it and the environment in which it is located".*

*Note 9. After all, it is also the functional aspect most replaced during the life of any artificial event. From the reuse of historical buildings to the reuse/re-valorization of objects produced in different cultural moments, once they have lost their value of use.*

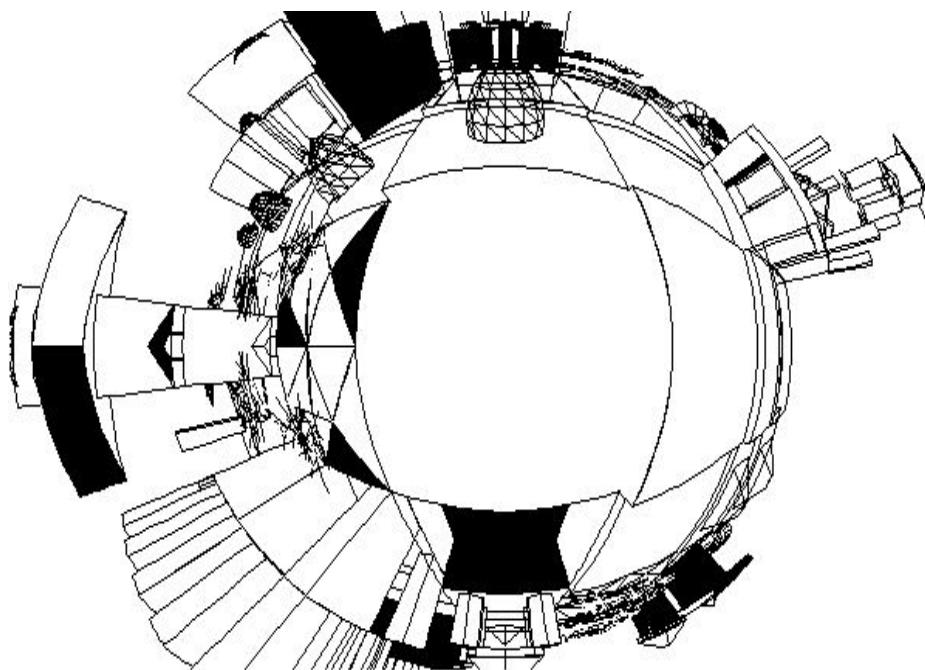
*Note 10. The relationship between randomness and creativity/scientific discovery is essential. Creativity is born from the ability to catch on the fly, and transcend, the contingent/casual (therefore also from luck, understood as coincidence of chance and ability to synthesize). Randomness, therefore, has heuristic value in the process of discovery. See the following chapters on the project.*

*Note 11. The identity and characterization of a subjective logic of approaching the project as a transformation of the world, proposes again, with Kant and Habermas, "the turning point from a unity of reason borrowed from the objective orders of the world to a reason as subjective faculty of idealizing synthesis. J. Habermas, "Il Pensiero post-metafisico", Saggittari Laterza, 1991 (1988).*

*Note 12. it is interesting to note that it is precisely the non-equilibrium that generates a "coherent" system of interaction in the environment in which we operate. To make this explicit Prigogine proposes an example:*

*"A simple example, the instability of Benard, will illustrate what I mean. The instability of Benard occurs in a liquid layer heated from below; once a certain threshold value is exceeded, convention currents are created, which result from the interaction of non-equilibrium between the heat flow and gravitation. It is interesting to note that each convention cell includes a number of molecules of the order of 10 high at 22, a huge number of particles. The non-equilibrium therefore creates coherence, allowing the particles to interact over long distances. I like to say that matter in the vicinity of equilibrium is blind because each particle sees only the molecules that surround it; while far from equilibrium the long-range correlations that allow the construction of coherent states are produced and that today we meet in many fields of physics and chemistry" Gregoire Nicolis Ilya Prigogine, "The birth of time", Theoria 1988, op.cit.*

*In the figure, a virtual scenario of possible environmental arrangements generated by one of the species projects carried out. The three-dimensional models have been represented in an anamorphic perspective in order to trace the totality of the space perceived by an observer placed at the center of the environment. The representation system adopted is a re-proposal, through an experimental software designed by C. Soddu, of the Flemish anamorphic perspectives at 360 degrees that used, as a reading interface, a cylinder of mirror placed in the center of the drawing.*



## QUALITY AND VIRTUAL IMAGINARY



[1] Darf, wenn lauter Mühe Leben, ein Mensch  
Aufschauen und sagen: so Will ich auch seyn? Ja. So lange  
die Freundlichkeit noch Am Herzen, die Reine, dauert, misset  
Nicht unglücklich der Mensch sich  
Mit der Gottheit. Ist unbekannt Gott? Ist er offenbar wie der Himmel? Dieses  
Glaub'ich eher. Des Menschen Maass ist's. Voll Verdienst, doch dichterisch, wohnet Der  
Mensch auf dieser Erde.  
Holderlin

To measure presupposes having acquired a term of comparison, a yardstick. Although this meter, as is the case with quality, remains essentially subjective. [2]

Has one always wondered if it is possible to measure quality globally? If it were, it would certainly not be feasible by summing one after the other the ability to respond to individual requests, proceeding analytically along with sequences and chainages of cause and effect. These procedures, if theoretically they could lead to total measurement, would practically be too complex, circumvoluted and dimensionally almost infinite; so much so that they would be impractical especially if an exhaustive answer were required.

When we operate analytically, even if we limit ourselves to sections that we think are significant, we often fail to close with acceptable evaluations. In fact, it may happen that, even if the individual parameters that, sectorially, measure the quality of the environment you are planning are high, the total quality, measured by the desirability, total enjoyability

of the site may be consistently lower. It cannot reasonably (and practically) be accepted that total quality can be quantified by analytical procedures, especially if implemented by summing up partial parameters.

It is much more interesting, and certainly more operable, to approach quality measurement not by successive sums but by differences. It should follow and retrace what is, in practice, man's way of placing himself before choices. Man possesses, perhaps unlike other living beings, the ability to imagine, trace and live with thought, worlds that are absolutely invented, non-existent in reality but virtually possible, desirable or detestable.

When man is faced with a choice he does not operate analytically [3] (also because he realizes that this cannot lead, in the long run, to evolution but only to the repetition of the already experienced), but imagines one or more virtual worlds. He opts for the most desirable one and according to this option he chooses among the various contingent alternatives the one that appears in tune, and therefore more directly usable to approach this virtual world.

It can also happen that if the distance between the virtual and real-world increases until it becomes unbridgeable, the desperation totally resets the virtual and re-qualifies the real in a new exasperation strongly "vital". As happens in cities shattered by insoluble problems that rediscover a new dignity not by hiding them but by exasperating them [4].

The design choice, especially if it concerns the character and structure of the environment in which we live, comes more from this type of approach to quality; which is, then, the humanistic approach. But not only the designer, but the end-user also makes his choices following this logic.

This does not mean that the designer, when operating, jumps evenly to systematic functional analysis. The designer uses ex-post performance analyses as a check on the appropriateness of the approach taken. The choice made, however, derives directly from the search for harmony with the mental image of the virtual world that he, or who for him, could and knew how to imagine.

But the imaginary of reference is in perennial evolution. And in evolution should be, in designers, the virtual scenarios of environments made in the image of man, the possible worlds to refer to.

Even in the project, in fact, measuring the quality of the environment, or of an object that is being created, operating through its performance can be not only exhausting but also practically unreachable. Let's imagine that we have to analyze, one by one, the individual responses of formalization to the requests, and, once each choice has been made, the subsequent response to each request formalized by the individual choices, and so on, continuing for exponential expansions of the field of investigation. The logic of comparing the existing, in its complexity, to the possible scenarios, to the virtual images that, subjectively or collectively, we are able to configure mentally and that represent the term of comparison, subjective but concrete (it is produced ad hoc) against which to assess the acceptability of the existing.

This logical approach leads, in the first place, to operationally re-evaluate the scope of the representation of the virtual, and we will try to resume this indication later.

Secondly, this approach proposes but also redefines, the two fundamental considerations in any investigation of quality. Two considerations that are, moreover, consequential: the interference, the predominance or, perhaps, the monopoly of the subjective sphere in the determination of quality and, as a consequence, the strong dependence of the measure of quality on the creative capacity of the subject, that is, on the capacity to configure possible worlds capable of overcoming reality. [5]

And this production of the imaginary must take place dynamically. As the real/projected world evolves (in the project and/or in reality) the virtual world of reference

also grows, amplifies the desirable potentialities, takes possession of every event of the real to operate project]ions on the improvement of the possible quality. [6]

The arrow between real-world and possible world measures, in negative and momentarily, the quality reached by the real. It traces the difference between the existing environment and the attainment of the one, between the possible virtual scenarios that reality itself has aroused in each of us, that appears more desirable as we walk through it and live mentally.

We realize that this is basically our way of evaluating quality from how we behave in front of what fascinates us.

In the face of beauty, of excellent quality, we remain breathless. And we tell, with this expression, our inability to produce a possible world more desirable than the one we have in front of us.

But as soon as we get used to it, as soon as we manage to mentally control what has dazzled us, the possibility of measuring this quality arises. It becomes itself one of the images of the possible. In fact, we rediscover the ability to produce imagery, to make our virtual world of reference grow and improve, and this precisely through the experience of what has fascinated us.

All this is part of our daily life. And every day we evaluate quality on the basis of the difference between desirable and offered, and not on the basis of analytical data.

And in everyday life, to remind us that quality can only be measured in negative, there is also the support of tendentious and guided projections in the virtual,

But if we return to the environment, and in particular to the design of the artificial, all this takes on a different value. Or better we can identify in a more pertinent way the role of the subjective sphere, and the contamination, or the progressive shift between subjective and objective (or better intersubjective) that the development of the project requires. And this traces the field of the relevance of the representation of the virtual as a quality control tool.

The design, in fact, is still a sequence of operations in each of which a choice is made between alternatives according to a possible desired scenario.

This involves the coexistence of three events/elements/devices: the ability to make a choice, the presence of alternatives from which to choose, the presence of possible reference scenarios, of virtual worlds.

In design, each of the choice operations is, in reality, a moment of formalization. The alternatives are formal alternatives (in a broad sense) and the use of a formal option is activated through the pre-figuration of virtual environments (architectures, objects, natural/artificial places, etc.). In this sense, virtual worlds proliferate and/or evolve.

Once the designer has opted for a choice, the formalized event is reintroduced into the real world (or into the design paradigm, which in the evolutionary dynamics of design configures the real) and evaluated qualitatively with respect to possible worlds that, in the meantime, may have had their own evolution.

In other words, just as the real world evolves acquiring new forms and new events, the possible worlds, or rather the conceivable worlds, evolve by structuring new scenarios that are increasingly desirable.

And it is precisely in this evolution, in this dynamic of successive accumulation of meaning, that resides the mechanism that makes it possible to measure the correspondence of the real to the intersubjective imaginary, i.e. to a universe of possible worlds whose desirability is plausibly shared by a great number of subjects/individuals. And to dimension, therefore, quality as a value capable of generating consensus.

This process involves:

1. that the possible worlds, the virtual architectures/objects/environments, and therefore the representations of these worlds, possess an evolutionary dynamic possibly in

tune with the process of slipping between subjective and intersubjective spheres. This means, given the previous assumptions, that this evolutionary dynamic contains an increase in complexity, an increase in possible meanings, an overall response/scenario always less and less distant, therefore, from an "objective" value, understood as the ability to respond pertinently to any possible and random individual approach. The achievement of the objective sphere is therefore seen as the achievement of a universe of possible subjectivity. [7]

2. that each formalization choice that is made (subjectively) in a request/response cycle is re-proposed as a request in the next cycle. This essentially allows, in the project time, the achievement of two objectives:

A. the achievement of functional plurality and the accumulation of meaning, with the subsequent purification of events categorically referable to exclusively subjective approaches (i.e. that cannot take off from their contingency/categoricity).

B. The construction of a logical structure of approach to formalization that also allows the gesture, the exceptional event. The exception, in fact, is necessary because it is able to operate paradigm shifts that allow the proliferation of virtual scenarios. But to implement this, the same exception once operated, must be put back into play, as a subsequent request, to really have a role in the growth of complexity of the artificial event.

3. that the succession of the formalization cycles traces an evolutionary dynamic of the possible images, of the desired architecture, configurable as an increase in complexity, an increase in the informative capacity of the project. [8]

The number of alternatives with respect to which one operates, and therefore the number of possible scenarios that the designer is able to configure, directly affect the information capacity, therefore the overall response capacity of the designed environment<sup>9</sup>. This quantity, if it does not yet measure quality, is certainly an effective evaluation key.

For this to happen it is necessary that information is not lost during the process, that every choice between alternatives retains its capacity for information while remaining legible in the development of the project. And readability is measurable by the possibility of configuring possible scenarios that could be real if that particular choice had been implemented differently. The informative capacity is therefore also linked to the permanence of the possible if as a historicized reading of the bifurcations occurred, therefore to the real growth of complexity of the virtual as a proliferation of the universe of possible worlds. only make configurable the possible worlds due to the alternatives not used, but all the possible worlds that the acceptance of such an exception has denied because the exception itself has determined a singularity in the evolutionary line of the project. And a singularity can also instantaneously double the informative capacity of the project because by transforming the circumstantial paradigm adopted previously, therefore widening the reference context of every single choice, each form operated varies in meaning [10].

This would not be enough to increase information. That instead happens if this variation follows an evolutionary line of growth of complexity, and the new meaning does not replace the previous one, but overlaps it in a simultaneous coexistence, waiting for the subjective activation that will be implemented by the user.

Simulating these processes on the computer [11] can be essential for two purposes: to increase the operational capacity of representation as an instrument of design control, and therefore of design quality; to increase, through the enhancement of the representation of the virtual, the process of progressive shifting from the subjective sphere to intersubjectivity understood as the simultaneity of infinite potential subjectivity.

In fact, the operational tool developed in our research operates within the

real/virtual difference and existing event/world desired with a dual purpose. First of all, to represent the plurality of possible worlds that are highlighted by the single choices, a production of virtual scenarios derived from each single compositional idea, which makes the qualitative evaluation of the compositional process in progress feasible; secondly, a concrete representation of the evolutionary dynamics of the design idea through the continuous increase of complexity of the virtual worlds represented. In this sense, the operative contribution of this instrument is concretized in the explanation of the evolutionary dynamics from subjective to the intersubjective sphere, allowing an operative evaluation of the quality growth in the project.

The possibility, activated with this experimental tool, to produce universes of possible formalizations as projection of single compositional ideas, already allows us to verify operationally that the proliferation of forms does not coincide with creativity, but is only a representation of the idea, which can be understood as logical/formal DNA, as post-metaphysical structure of the idea itself [12]. This gives undeniable operational importance to the choices made on the evolutionary logic, to the instruments that allow, dynamically representing the system along with its evolution (linear and non-linear) these choices, and therefore to the evaluation and control of the idea upstream of its infinite concretizations in form.

More in detail, and specifically as regards the measurement of quality, the experimentation carried out has led to some considerations, and essentially to identify the elements capable of influencing the design quality of architecture, in terms of inter-objective appreciation, and therefore objectively acceptable.

First of all, we experimented with the possibility of accessing plausible measures of quality through a series of quantifiable parameters:

1. the quantity of choices/events made in the design process, measured in terms of information and, in a translated way, as an accumulation of meaning and therefore shifting from subjective to intersubjective.

2. the awareness of choices, quantitatively determined by the ability of each choice to remain in development, and by the recognition of previous choices as a patina of time. It can also be evaluated by the increase of diversity among the virtual scenarios produced by the simulation process.

3. the quantity of basic alternatives for each single choice identifiable, in the real activity, such as micro scenarios, cultural/historical references, systematized experience, creativity, etc.. In the simulation are activated procedures for the production of alternatives, gene-rates through interpolation between devices of formal, geometric, dimensional, structural, complexity, etc.. These generation procedures are not configurable as a catalog/abacus but they propose a universe of references in continuous evolution and, practically, without pre-established limits. In other words, the superimposition of linear dynamic systems is activated experimentally to produce resonance, which is a non-linear dynamic system, as it happens in the activity of the natural genetic code.

4. the availability of the design logic, and of the adopted simulation logic device, to accept and manage exceptions.

This point becomes particularly important because the information capacity/exception ratio is not linear but, for each system, has a peak. In other words, while the information capacity initially increases in relation to the presence of exceptions in the evolutionary paths, this growth tends to become stationary for some values [13] and then decreases continuously. It is evident, in this, the onset of the impossibility of making the memory of the choices made persist if the increase in exceptions becomes incessant.

If, on the other hand, we want to identify the elements that, at a first experimental

examination, are irrelevant on quality (as it has been understood in this experiment), we are faced with some extremely surprising clues.

1. First of all, the structure of the single choices, the formal gestures, become irrelevant in the

development of the process of slippage from subjective to intersubjective. For the information structure, the single gesture is not important, but it is important that it arises from the conscious evaluation of alternatives. On the contrary, overestimating a single gesture can also compromise the increase in complexity, the achievement of a universe of meaning capable of responding simultaneously to a plurality of different subjects/individuals.

We could say that the single gesture is comparable to a catalyst, which enters as an indispensable element in triggering the process of quality formation but is not substantially involved. It defines the cultural reference, the subjective conceptual need, we could say the "style", but it is indifferent to the global quality, which instead is more affected by the number of alternatives from which each gesture is born.

2. The functional relevance of the references, of the individual possible scenarios used to organize the project paradigms, is irrelevant to quality. If the virtual references/scenarios are not very relevant functionally, there is a drive both to their proliferation and to their progressive evolution. A unique and relevant initial scenario proposes prematurely categorical and definitive choices in the development of the project, closing the same evolutionary process early.

3. Also irrelevant to the achievement of an informative capacity and response to the multiplicity of possible requests, and therefore, according to the premises, to the achievement of quality, are the characteristics assumed to define the limit between norm and exception. The important thing is to have defined them and therefore make the logical leap from one paradigm to another every time we find and accept an exception. On the contrary (since managing an exception in an evolutionary way means re-evaluating through superimposition and not replacing the sense of each previous choice) if we imperviously define the exceptionality, this can structure a deterrent, a further difficulty for the recovery and accumulation of meaning that is transferable in the new framework of reference.

These are the first findings that, even if partly predictable, emerge from our experimental approach. This approach is therefore within the possibility, that science offers today, to activate areas of experimentation and simulation in disciplines that were, until recent years, substantially devoid of them.

This experimental research of simulation of the evolutionary dynamics of the project is also configured as a way of attacking the theme of the quality of the environmental image, and offers indications that can be quantified experimentally: the measure of quality does not depend on references, style, individual choices or exceptional gesture, but is then measured by the compositional logic activated, the ability to manage and control the evolutionary mechanisms of the idea, the quantity of alternatives considered and the awareness of making choices even when, apparently, "there are no alternatives".

*Note 1. [Can a man, when his life is but pity, look at the sky and say: so too I want to be. Yes. As long as friendship / Outspoken friendship still lasts in the heart It doesn't hurt man to measure himself / With divinity. Is God unknown? Is He manifest and open like heaven? That / Rather I believe. This is man's measure. Full of merit, but poetically, dwells / Man on this earth.]*

*Note 2. Fernando Pessoa, "One multitude", Adelphi 1984 (1942) "The Tagus is more beautiful than the river that flows in my village but the Tagus is not more beautiful than the river that flows in my village because the Tagus is not the river that flows in my village".*

*Note 3. Compared to the difficulty of an analytical "measure" of complexity: René Thom, "Structural stability and morphogenesis", Einaudi 1980*

*"One of the essential difficulties comes from the following fact: given a dynamic system parameterized by a form F, the complexity of F is very rarely defined intrinsically linked to F; in general it will be necessary to immerse F in a continuous family G and only the topological complexity of F relative to the continuous family G can be defined".*

*Note 4. From "Rasoi", by Enzo Moscato, quote by Pier Paolo Pasolini:*

*"The Neapolitans today are a great tribe who, instead of living in the desert or the savannah, like the Tuareg or the Boja, live in the stomach of a large seaside town. This tribe has decided - as such, without answering for its possible forced mutations - to become extinct, rejecting the new power, that is, what we call history, or otherwise, modernity. The same thing the Tuaregs do in the desert or in the savannah the Boja (or they have also been doing, for centuries, the gypsies): it is a refusal, born in the heart of the community; a fatal negation against which there is nothing to be done. It gives a profound melancholy, like all tragedies that take place slowly; but also a profound consolation, because this refusal, this denial of history is just, it is sacrosanct", Pier Paolo Pasolini".*

*Note 5. Geoffrey Scott, "The Architecture of Humanism," Dedalo 1978.*

*"Nothing can, therefore, be of help to the architect except the wider capacity to "imagine" what the spatial values resulting from the complex conditions of each particular case are: there is no freedom that he cannot sometimes take, and no "fixed relationship" that he cannot fail to take. Architecture is not a mechanics but an art, and those theories of architecture that provide beautiful, ready-made texts for the creation or criticism of design already carry their condemnation".*

*Note 6. The paths of growth of the real/projected and the imaginary of reference are parallel but independent and feed differently. Let us remember the representation of the growth of the imaginary world in the statue dance in "The Wild Planet" by Topor.*

*Note 7. Geoffrey Scott, "The architecture of humanism", Daedalus 1978 (referring and integrating the approach developed by Lipps and Berenson)*

*"Architecture is, as a whole, invested by us with human movement and attitudes. To this principle is added a complementary one: we transcribe architecture in the terms that are proper to us. This is the humanism of architecture. The tendency to project the image of our functions in concrete forms is the basis of creative design for architecture".*

*Note 8. René Thom, "Structural stability and morphogenesis", Einaudi 1980*

*"...one should not believe that a linear structure is a necessity for transporting or storing information (more specifically meaning). Although the idea is not familiar to us, it is not impossible that a language, a semantic model whose elements are*

*topological forms, can present, from the point of view of deduction, serious advantages over the linear language we use. In fact, topological forms lend themselves, through topological product, composition, etc., to a combination infinitely richer than the simple juxtaposition of two linear sequences".*

*Note 9. In terms of the information, it is worth remembering that a bit of information conventionally represents the informative power of a choice between two alternatives. A choice between four possibilities is measured with two bits. M bits are  $2^M$  possible choices.*

*Note 10. The reference is to Wittgenstein, and to the ambiguity of reading single images as multiplicity, simultaneous of possible meanings whose contingent plausibility depends on the reference context. A classic is the rabbit/goose image, also used by T. Kuhn.*

*Note 11. These simulations were realized by Celestino Soddu in 1987 and published in 1989 in "Città Aleatorie", op.cit.*

*Note 12. J. Habermas, "11 post-metaphysical thought", Saggittari Laterza 1991 (1988).*

*In reference to Kant's Critique of Pure Reason: "So that the subject does not sink, forgetting himself in the current of his experiences, he must be able to maintain himself as the same subject.*

*Only this identity established in apprehensive self-consciousness, which is not given empirically at all, but is presupposed transcendentally, allows me to attribute all my representations; the multiplicity of my representations acquires, only through the transcendental unity of apperception, the continuous connection of my own representations, belonging to me as a knowing subject.*

*Note 13. The values in percentage of the number of exceptional events acceptable by the system depend, necessarily, on the logical approach, on the type of evolutionary dynamics that have been triggered. For example, In the experiments carried out on the dynamics of urban image transformation (C. Soddu, Città Aleatorie, op.cit.) the optimal values as peak information were between seven and eighteen percent.*

## **COHERENCE AND INTERCHANGEABILITY OF POSSIBLE FORMS**



*Di te, Finzione, mi cingo fatua veste.  
Ti lavoro con l'auree piume che vestì prima d'esser fuoco  
la mia grande stagione defunta per mutarmi in fenice lucente!  
E. Morante, "Alla Favola", in "Menzogna e Sortilegio"*

Every time we walk in the historical center of a city, such as in the baroque nucleus of Rome, with complex historical and cultural stratifications, we rediscover, in the same street where we have passed thousands of times, an extremely characteristic piece [1] that becomes immediately necessary. But also exciting, precisely because we have defined this necessity a posteriori, once we have rediscovered the element, and it is, therefore, unthinkable to transcribe this necessity as a recognition of a mythical origin, capable of explaining everything. It is only a piece whose necessity is a mirror of our subjective reconstruction/rediscovery, a re-emergence, and explicitness in our imagination of forgotten potentialities.

It is difficult to admit that this new rediscovered element, while so strongly characterizing and necessary, has not changed the total image we previously had of the site at all. Its discovery, once it happened, did not change the idea we had of that place, the recognizability, and uniqueness of the *genius loci*.

Ideas, in fact, are "concepts that design the world", "they have heuristic value for

cognitive progress [2]. They are therefore not something static, nor objectively capable of a final explanation.

Therefore, the idea being the project of a subjective logic, it cannot change itself for a discovery (ideas feed on rediscoveries), they can only evolve and acquire complexity.

But now that the discovery has taken place, the form becomes necessary. The image of the place, the subjective idea that we have of it, could paradoxically change precisely because of the lack of that event...

From all this comes, for the designer, a first question: how much, and when, is a specific form, chosen among the others possible, important to achieve a certain architectural quality, or rather, to realize a compositional idea? And what is the relationship between the presumed need for that form and the temporal evolution of the project, the progressive shift from subjective to intersubjective, the progress towards complexity as an indispensable component of the project's quality objectives?

First of all, we have to specify what meaning we intend to give to the term form, in the peculiar field of design: a specific choice/ gesture of formalization that responds to one or more requests present in the project; but also a circumstantial paradigm [3] capable of organizing in a structured whole a universe of requests, constraints, pertinence, potentiality of materials, conceptual needs of cultural identity, desirable references, and so on. But how is a form produced when designing?

When we face a specific design choice, when we produce a shape in response to a request, we realize, with a mixture of vacuous horror and creative exaltation, that we can opt for one shape or another. The question we ask ourselves is: is this due to an incongruity, a lack of clarity in the development of the project or, on the contrary, does it indicate to us that the hypothesized shapes are interchangeable? Or rather, that the development of the project can continue in different but interchangeable ways? [4]

If we accept the substitutability of one possible form with another, we accept that this depends on the fact that these forms are not necessary to achieve the desired quality. Or rather, that they are not already necessary when they are chosen (or rediscovered, as in the example of the Roman walk). The experience, and also the experimental simulation of the design processes that we have implemented, leads us to think that, in reality, such forms do not pose themselves as necessary, and therefore a substitution between countless virtual congruent forms, understood as different and parallel ways of achieving the same goal, is possible. But at the same time, we realize that each of these formalizations, once traced, becomes necessary as a structure an irreversible event, a procedure implemented, in the evolutionary dynamics of the project. And this even if, later on, that particular choice of formalization will apparently be canceled by the subsequent evolution of the design.

There is no doubt that the choice of a formal alternative instead of another leads to very different results. But it can only be a contingent diversity. The logical compositional approach of the designer remains identical. Parallel results are all virtually possible, all capable of identifying the same design matrix if the interchangeability of form is associated with the continuation of the logical procedures of morphogenesis. [5]

There is, in fact, a recognizability/characterization as a species (which can, in this case, be referred to the subjective design logic of the designer, or to the philosophy adopted by an industry in the creation of objects, or to the genius loci of a city, and so on), and a characterization of the individual/event, episodic and contingent (a particular work by a designer, Gubbio among medieval cities, a self-portrait of Rembrandt among others, the pine tree in front of the house among other pines...).

This means that it is possible if one is considering the character of the species, interchangeability between individuals belonging to the same set. The possible diversity

is represented by the fact that emerges, at each substitution, a parallel virtual history, born from the bifurcation that the possible alternative between two forms has created, but which proposes, in one more further internal variant, the same characters of species.

It is as if, having as a field of evaluating the quality, recognizability, and characterization of a particular garden, we wanted to analyze the incidence, in the total reference image, of the replacement of a peach plant with another peach plant.

Belonging to the same species would still guarantee interchangeability, despite possible differences between individuals. Every choice, and above all the evolution that arises from this choice, characterize the individual. The above-mentioned peach plant, for instance, once planted, can be particularly fertile of exceptional fruits, or can assume a certain shape which characterizes the place, or can condition, with its own growth, the whole surrounding environment. All these evaluations are unpredictable and therefore not relevant as reasons for the choice. But essential, in retrospect, for the specific character of that place.

This interchangeability should therefore not be assessed as indifference between the various options. One form may be interchangeable with another at the time of choice. But each choice, once accepted, comes to be irreversible, and univocally and necessarily characterizes the individual, a story among the many possible stories, but, as a story, irreversible.

The awareness (also operational) of this distinction between the choice between forms and compositional mode is an essential part of recent cultural history. It was made explicit precisely in the Modern Movement, and indeed it was one of its premises. The Modern Movement has in fact assumed, in architecture and design, an approach aimed at evaluating as hierarchically more meaningful and meaningful the design process to be activated than the individual formal exits. And very often even going beyond, and perhaps deluding oneself, of being able to resize the role of decorations as forms not directly connected to the design choice. The result is a charge of axiomaticity in the logical approach to the project, and a theoretical loss [6] of complexity understood as the simultaneous resonance, co-presence, of the same project, of different logics.

This has considerably affected not the characterization as a species (the identity of the modern city is very strong) but the characterization of individuals. (Modern cities, the result of the deviant Modern Movement that is the International Style, tend to a loss of image, to a homologation that is felt by users as a lack of capacity of characterization, of response to specific and diversified human needs for identification).

Having worked with different forms (which in the case of the modern world sought objective essentiality, but were still interchangeable), and above all with logical approaches univocally wanted and idealized, has led, (however, this strong approach is evaluated), the revaluation of a compositional ontological field. This field, thus constructed, had necessarily to disregard the indications of the need for specific forms, as they were previously used, and codified academically [7], in order to achieve the set objectives of environmental quality.

The choice of the Modern Movement (and generally of all the avant-garde movements at the beginning of the century) to break down the academicism of specific forms and decorations, in order to achieve "quality", has resulted in an attempt to shift, irreversible and extremely productive on the cultural level, the field of design from the project to the meta-project [8] (today we would say, in the light of the experimental approaches implemented, from forms to formal logic).

The attempts made since the 1950s to meta-project have laid the foundations for the species project.

But with one essential difference. While the meta-project was the search for a global, objective approach to environmental quality, the project of species is a subjective

meta-project, i.e. a project that highlights, defines and controls the subjective procedures of approaching complexity. Having as objective the ability of the built environment to respond to the intersubjective needs of man.

The objectivity/optimization of the solutions (never of the approach) is only plausible and probable.

In the historical avant-gardes of the twentieth century, in order to activate the supremacy of compositional logic over the individual choices of formalization, support and synergies were sought in the experiences that, in parallel, were carried out in other scientific fields. On the contrary, it is probable that the desired synergies with scientific research, which at the beginning of the century was not yet fully aware of the need to work on complexity, but was still aimed at the search for total and unifying coherence, has triggered a deviant process favoring the growth, in parallel, of a reductive image of design. In the name of the determinism still prevailing in some scientific fields, the coherence is exalted as a categorical approach, which is objectified, and consequently requires the "necessity" and "uniqueness" of every formal choice.

The functionalist approach, although harshly criticized within the avant-garde itself [9], finds its consecration in the profession. The crack in this logical construction deliberately and stubbornly adamantine is given by the fact that the need for form, the cause/effect relationship between requests and forms, in real design operations, is always reassessed *a posteriori*. And it cannot be otherwise because an inductive/deductive, or in any case deterministic, the process between request and form cannot be realistically activated. It is a simple question of quantity: the field of the pertinence of the forms always exceeds that of the non-formalized requests. The latter cannot involve, and therefore univocally define the former.[10]

This misleading attitude towards the project has irreversibly contaminated our cities. In fact, an approach based on the *a posteriori* justification of each choice as a reconstruction [11] of a previous deductive logic has rapidly and tenaciously spread. The justification that, operated in deterministic terms, reduces because it cannot be traced back to the parameters used, both the total quality and the very field of contractability of the environmental requirements related to the image. The objectives to be achieved, in fact, were, and very often still are, identified and programmed only if they can be easily traced back to quantifiable data. The quality of the environmental image is not, in this operational field, contractable and therefore is excluded from the same program. [12]

This widespread reductive approach to design is based on an act of unjustifiable presumption.

The necessary and bi-univocal correspondences between forms and functions are defined in a fanciful and artificial way [13] when today it is clear to everyone that this correspondence is neither necessary nor bi-univocal. If a correspondence can exist, it varies from the field of the subjective to that of the random.

And this variation grows if, as is necessary, we bring the project back to its specific temporal dimension, as an integral part of the becoming of the environment we live in.

Architecture, like all design, from the city to the object, has a common denominator. It works by structuring complex answers to questions that are only partially known. How can a designer know everything that every possible user, every man will ask the environment/artificial object (from the aesthetic to the strictly functional level)? Every man, in fact, is a different individual, with his own subjectivity. Moreover, it is likely that he belongs to a different historical and cultural moment, even temporally, from the designer's reference context (architectures, as well as objects, are also made to last, and in any case to exist beyond the time of the project, their duration is always "long" in relation to the rapid evolution of needs).

But the Pantheon, as well as being a historical artifact, is still capable of responding to our needs, identifying itself as an eternal, timeless space. The Rotunda of Palladio is still a villa that responds to the collective imagination. How did these designers know how to respond to the needs of contemporary man, so different, unpredictable in the eyes of an architect of centuries ago?

Leaving aside the search for "immutable" that would, however, offer objective and objective keys of interpretation aimed at the re-proposal of the truth, and therefore at the Cartesian decontextualizing abstraction, what could be the key to this uninterrupted public success? Is it possible in the project to control and evaluate a priori the logical procedure that leads to the realization of events whose "necessity" will still be shared centuries (or minutes) later?

Every choice of formalization comes from the subjectivity of the designer and is expressed through more or less cultured, historical and/or fashion references. In any case, it goes beyond, without exception even in the most "simple" cases, the field of the pertinence of the needs that generated it. This means that if the designer also places himself in a determined manner within a consequential approach, and justifies a posteriori his every act of formalization as necessary to achieve the goal, in fact, all this is artificial because it will always be possible to find not one, but infinite formal solutions that respond equally well and in a pertinent way to the needs expressed to justify the choice [14]. In practice, it is always possible to deny any previous "necessity" regarding individual choices.

If this practice of justification a posteriori is a deviant professional custom, the key to the original theoretical approach of the Modern Movement is extremely different. The Cubist experience already proposed the plurality of forms, or rather their simultaneous temporality, and attempted a parallel representation of an interchangeable universe of possible formal/temporal evolutions. And this experience was one of the formative references, when not also an explicit formal reference, of the architecture of the twenties and thirties.

In these Cubist experiences there was already a determined tendency to a dynamic representation of the fourth dimension, and therefore to what, today, is the project of species: logical-formal, morphogenetic control of the possible transformations of form.

After all, this approach was not even new, I would say that it has always been a constant, even if not explicit, of the artistic work. Today, in fact, we can make a reading of some works of art belonging to extremely different cultural moments, which highlights a component of art-making that tends to concentrate in representation not only a multiplicity of parallel facets of meaning but also the history of formal evolution in a possible temporality. For example, it is possible to read this simultaneous stratification of possible temporal readings also in 14th and 15th-century paintings in which the events told, and the context itself, through dimensional and perspective deformations of the image, propose possible paths and temporalization. [15]

In contemporary architecture this potential has exploded, if only as a trending demand, because architecture has always been one of the mirrors of society, and society today is complex and stratified hyper-communicative and multimedia. Abandoning categorical references to the truth, with the crisis of ideology, it makes the same interchangeability of forms its own. After the high tech experiences of the seventies and the postmodern ones of the eighties, architecture and design find fertile ground in this kind of theoretical/experimental approach. On the one hand, there is a tendency to develop the compositional approach to complexity, comparing it with the simultaneous development of scientific research, and finding new synergies; on the other hand, it is possible to find, in the loss of credibility of methodological/compositional assumptions re-proposing the ideology of coherence, the need, and urgency to redefine the ontological

field of design.

These themes characterize the debate [16], still ongoing, between modern, nostalgic vetero-moderns, post-modern and neo-modernist. They often re-launch arguments that do not fully evaluate the ongoing redefinition of the ontological field pertinent to the same compositional disciplines.

In fact, on the one hand, it remains, deviant and falsely nostalgic, the defense of the necessity of every single choice of formalization made in the project, pretentiously linking to this presupposition, operationally unacceptable but contractually irrefutable, the same dignity of designing.

The principle of dignity to which this approach refers is, as well as obviously acceptable, the very basis of design. The equating of the dignity of design with the logical control of the project is, in fact, an essential point of reference. The distortion lies in the type of logic control activated: the "necessary" sequence between request and form. The defenders of this approach base their arguments on an assumption: the impossibility to make credible, and feasible, a different approach, which is controllable (and therefore really and worthily designed), and which operates directly, and in progress, on the shattering and interchangeability of form. Instead, this is possible, and the experimentation we have implemented is a possible demonstration of this.

It is possible to operate with a design dignity, therefore activating relevant and adequate control instruments, on the interchangeability of forms in a dynamic growth and evolution of choices, complexity, quality as a progressive approach to an imaginary reference, also in evolution.

This approach to design is not only possible (and in synergy with the parallel revolution in scientific research) but necessary to recalibrate and give new dignity to the architect's work itself.

The objective of the nineties can only be to regain the dignity of the project (and therefore of the environment, architecture, the object of use, the city) in the capacity of logical-formal control of design and temporal transformations, identifying objectives whose quality transcends, without denying, the contingent, the subjective and the random.

In other words, it is to operate designally on the formal genetic code, on the DNA of the form (architectural, urban or industrial object) in the awareness that the interchangeability of individuals/form within species, and the simulated temporality of the process, will take nothing away from the compositional quality of the designed environment. This quality will live and will respond to the even unpredictable demands of man, through the adaptability of what arises from the non-equilibrium, from the control of the same evolutionary dynamics that underlies the environment in which we live.

In contrast to the functionalist/deviant attitude, the architecture of the 1980s, postmodern objects, while working on the interchangeability of forms, and in line with real expectations of contemporary society, did not produce a systematic and sufficient revision/evolution of the compositional process and the relative disciplinary field. Many of these experiences were, for this reason, easy prey to critical attitudes superficially inspired by the modernist experience. Critics who question the recovery of styles and forms of the historical heritage of architecture, as such recovery would not be conscious, the result of a cultured approach, but superficial and/or random.

A criticism that can be shared, provided that it defines what should be considered, for a designer, an approach relevant to his/her own references. It is certainly not only an approach oriented to historical research, within acquisitions and critical/analytical evaluations that prescind from the real field of the pertinence of the composition/discovery. For a designer the approach must be based on the awareness that design is the management of the contingent and the random; that creativity is knowing how to insert in the design field one's own subjectivity and incoherence as a catalyst of

evolutionary processes that cannot, and must not necessarily, be foreseen, but with respect to which one must activate one's own logical coherence, which is not a coherence tout court, statically defined as firmness towards every possible contradiction and multilaterality, but a becoming of ways to transform reality towards the imaginary of reference, also in evolution. Coherence as maintenance of the tension to the progressive approach of the virtual reality of the project to the imaginary that measures its quality.

If the recovery of "historical" forms operated in the architecture of the 1980s can be judged random, trivial and uncritical, this negative assessment cannot be based solely on the consideration that history is used as a deposit/catalog. In reality, such a deposit/catalog not only does not exist but cannot exist.

Each of us refers to (and criticism of) the concept of history debated in recent years confirms this [17] to our own subjective representation of the history of architecture.

A representation, therefore, that is not a catalog but, however, it is implemented, a subjective one that emerges in the contemporaneity of formal matrices. A redesign and re-signification of formal events whose semantic and functional transformation is uncontrollable a priori and evolves over the subjective time of design.

And if this reading can, from the point of view of a different discipline, be considered random and contingent, this does not detract from the fact that perhaps it is also possible that it is, precisely because of these peculiarities, more consonant with the design than others. This means more responsive to the need to stimulate the growth of the project, always structuring new, incoherent and unpredictable points of view [18] capable of catalyzing the growth of complexity of the architecture, of the environment that is being traced, and therefore its ability to respond globally to the possible unpredictable and subjective demands that will be placed on it.

This, however, does not want and should not be an a posteriori justification for reductive simplifications of compositional thickness and design quality itself. A quality that can also ignore the formal references used, but cannot but presuppose a conscious logical approach.

If, in fact, we want to reformulate a critique of certain contemporary compositional approaches that appear uncritical and superficial, we must certainly refer not to the subjective recovery of a formal heritage, but to the possible latitude in bringing this work within a logical control that is not analytical but truly "design".

In fact, if we try, in the absence of an "alternative" logical approach, to combine the objectivist/functionalist design approach codified by international style with the demands of contemporary society, we find ourselves unable to proceed. The theoretical assumptions proper to pseudo modern deviance, the categoricity of choices, the necessity of gesture and deterministic coherence, cannot, in fact, coexist with the attempt to achieve the complexity, characterization, and interchangeability of forms proper to the contemporary image/environment and its quality referents.

If this mixture is attempted, the result is marked by the inevitable need for simplifications that have a reductive effect on environmental quality.

If we want to achieve the overall response capacity that the contemporary world demands from the environment, both natural and artificial, the operation to be activated is much more complex and is certainly not only linked to specific objective and optimized problematic aspects, or to reference images that can be set, occasionally, as an objective to be achieved.

This is an operation that must bring into play not only some theoretical/operational principles consolidated and sclerotized by decades of professional functionalist practice but the same ontological field proper to the discipline of composition.

First of all, it is essential to clarify what the coherence and interchangeability of form mean from a design point of view. In the compositional process, it can mean making

a distinction, splitting in the design formalization, between what is the indispensable subjective contribution of form/response, which pursues the characterization of image and the achievement of an imaginary reference, and the "necessary" margin of the same response, which is limited to the adaptive capacity of the produced form to also include a response to the request. And this to all the scales at which choices of formalization are made in response to needs.

This leads to the need to identify the real contribution to the complexity and the recognizability/characterization of the designed object of the two essential components of the design process: the forms and morphogenetic processes activated.

The forms, chosen subjectively and/or randomly, can be interchangeable, and these previous alternatives, once the choices become irreversible, will act, as a surplus of information, on individual characterization. On the contrary, morphogenetic processes, when they are modified, directly affect the recognizability not of the individual but of the species. Therefore, they directly influence the recognizability of the compositional and cultural paternity of the work.

Interchangeability of shapes and variation of morphogenetic procedures are the two keys through which it is possible to activate design simultaneity between individual sphere and species. It is no coincidence that today we rediscover the taste and cultural interest for a mechanism that has been, at least in part, in disuse for a few decades: decoration as superimposition, at various scales, of significant structures that are not correlated but often unpredictable with respect to each other.

If operationally, "individual" diversification is problematic (there are no longer craftsmen in architecture buildings, the production is still that of mass-produced objects, all the same, the production of objects, such as "swatch" watches, diversified and colored is still a sporadic fact and made in a hybrid way), the contemporary need to find it in the project persists.

In fact, making a leap of scale, the postmodern attempt is to re-propose the stratification of meanings and the interchangeability of the elements of a decorated historical architecture (the capital can be made by any craftsman, as long as he is good, but the architectural quality as compositional quality does not change). This using the interchangeability of references also activated randomly as a simulation of the multiplicity of the subjective.

It is, however, always and only a matter of attempts to simulate a complexity, with autonomy at the various scales, using a reductive, if not even irrelevant, approach. This autonomy at the various scales, in fact, must be controlled on the level of construction/fragmentation of the image, on that of characterization and diversification species/individual, on the real dynamics of approaching the complexity of each evolutionary process.

In any case, all of this tells how an approach that explicitly, and brings into play, some requests that redefine the relationship between environment/man and subjective/social appears to be imperative.

The objective that is being defined, and that these contemporary experiences tend to achieve, is not only that of an autonomy of the project at various scales, and within these a possible interchangeability of forms, but also, and simultaneously, the achievement of a design identity of the artificial that guarantees, however, the recognizability of the compositional matrix, and therefore identifies the *genius loci*, the species of objects.

If this is the objective, and you want to pursue it by identifying a logical approach that can be operated globally, it is necessary to translate the design operation from the individual forms to the species of forms. It is necessary to undertake the project of the species.

A much-debated example: the medieval village. On the architect (but above all on

contemporary man as an increasingly crafty user of built space) the medieval town exerts a very particular charm because it is not easily identifiable with specific events. And it certainly does not derive from "lack of rationality" or scientificity, as some would have us believe by proposing generalized deregulation. On the contrary, in other ways, this possible lack can be a deterrent to appreciation.

The fascination derives essentially from the character of the species. The medieval village can be read, and appreciated, regardless of the individual buildings that make it up (some ugly, badly restored or new buildings do not strongly affect the ability to fascinate). On another scale, the charm of the individual buildings can also be assessed without considering the architectural features or details.

The aspect that most intrigues the contemporary is that this capacity of fascination is expressed, in the medieval city, without proposing a strong organizing character, but only a strong characterization of the genetic matrices. That is, without resorting to an overall idea that structures and makes the city recognizable through categorical and explicit gestures, such as alignments, hierarchies, and dimensions, but through the ambiguity and unpredictability of a genetic code.

The medieval city is in fact, in some ways simultaneously spontaneous and controlled. Therefore "rational" as the ability to control and direct the random. Each element has its own individual characteristics, but the presence of diversity does not deny but helps to form and amplify the character, the recognizability of the image of the medieval city.

As in nature, logical and surprising at the same time. As in a forest, where the proliferation of individuals (trees, bushes, flowers, etc.) and their transformation over time do not destroy, but rather amplify the characterization of the whole, the recognizability of a *genius loci*, the specific image of that particular place that, with these unpredictable (and interchangeable) transformations, acquires, and does not lose, identity.

An olive tree becomes more "olive" and, at the same time, more individual-olive the more it is scrambled by the wind, the more unusual, twisted and surprising its branches become. That is to say, the more it diversifies itself by expressing its strong genetic structure.

And an olive grove is more recognizable as an olive grove the more its component individuals have acquired diversity.

If we wanted to access, compositionally, to these results, it is unthinkable to operate according to design sequences of "necessity" on each branch. It is much more pertinent (and correct, as well as dignified) to design the olive tree as a species, defining not the individual elements, but the morphogenetic structure.

We will thus find again, on another scale, the planning and "rationality" that we superficially considered absent in the medieval village. A projectuality understood as the ability to relate operatively the reality to an imaginary reference, even complex but undoubtedly full of charm, which is expressed and redefined, in progressive evolution, as a collective imaginary.

The morphogenesis project is this: to respond to contingent (but also futuristic and unpredictable), cultural and image needs, etc., not through a unique and categorical formal event, based on "necessary" choices, but through the design of a kind of event, of a genetic code. A kind of formalized event more pertinent to needs as they are capable of adaptability. Within the species, each event is interchangeable with the other until it is chosen, it becomes irreversible; that is until the project has grown, and the form adopted (among other possible forms) has not been used as a response to the need for individual identity, but within a logic of contingent/casual control able to characterize, and dynamically re-evaluate the quality of the image of the environment.

The evolution of the species (and at the same time of the environmental complexity) does not break the recognizability of the environment, it does not homologate its image on the basis of pre-established standards of optimization, but, amplifying the endogenous potential, it becomes essential support, as historically it has always been, for the increase of identity, the dynamic maintenance of the *genius loci*.

*Note 1. Manfredo Tafuri, "La sfera e il labirinto", Einaudi 1980.*

*Quoting Foucault, "Nietzsche, genealogy, history" (1971): "Science is not made to understand, but to cut. ... to cut what allowed for the consoling game of recognition."*

*Note 2. J. Habermas, "Post Metaphysical Thought", p.cit.*

*Note 3. Thomas S. Kuhn, op.cit.*

*Note 4. Emanuele Severino, "Legge e caso", Adelphi 1979.*

*"But the concept of equally possible cannot refer to possibility as such. ... Something is either*

*is not possible: the possibility as such is not quantifiable. To say then that two events are equally possible means referring to the way possible can happen."*

*Note 5. An example that explicitly compares the role of the form and that of the transformation process activated and given by some experiments that can be implemented for the construction of fractal forms. If we take an initial form, and we subject it repeatedly to the same transformation (for example, we shrink it, lengthen it and choke it in the same way, then we insert it in the previous one), we arrive, after a more or less long series of iterated transformation cycles always in the same way, at a fractal form. If we vary the starting shape, the final fractal shape species does not vary, but only some peculiar characters, and limited to a short cycle of iterations. If we vary the process, the species varies.*

*Note 6. Actually' this is not true in practice, as the projects and architectures of the Modern Movement are anything but axiomatic. They undoubtedly possess a charge of complexity which, however, is theoretically denied. As Maldonado states "The image they wanted to propagate had to be compatible, indeed absolutely congruent, with their programmatic assumptions. And when the accounts did not add up, which was often the case, they would return anyway by resorting to the usual procedure of neglecting or hiding the elements that were, or could have been, in contradiction with these assumptions ... the real Ciam was better than the mythical Ciam. The real Bauhaus was better than the mythical Bauhaus" Tomàs Maldonado, "Il Futuro della Modernità", Feltrinelli 1990 (1987).*

*Note 7. Paul K. Feyerabend 'Against the method', Feltrinelli 1979 (1975)*

*"Scientific [academic] education... simplifies science by making it easier for participants ... is an attempt to inhibit insights that could lead to blurring the boundaries between one [research] field and another. An individual's religion, for example, or his metaphysics, or sense of humor, must not have the slightest connection with his scientific activity. His imagination is repressed, and even his language ceases to be a personal language. ... it is possible in this way to create a tradition... but is it desirable...? My answer to that question will be a firm and resounding NO."*

*Note 8. Andries van Onck, "Metadesign", in Edilizia Moderna n.85, 1965  
"Gaudi, Bill, and Rietveld start from the common premise of a speech preceding the particular project. This initial discourse is more general and more abstract. It is about the design of the parameters of a system displayed by a mechanism composed of moving elements, be they points, lines and planes or materials such as jute canvas. Within the limits of the possible configurations of the elements the variation that best corresponds, according to the designer, to the needs of the particular case is chosen. We will call the design of this visual-formal language meta-design."*

*Note 9. Edoardo Persico, "Oltre l'architettura", Feltrinelli 1977 (1935).  
"But I believe that as long as we continue to discuss useful art, art as an expression of time and society, following De Bonald or Le Corbusier, the profound sense of art, which is independence and freedom of the spirit, will always escape. This is the teaching not only of valid aesthetics but of the constant tradition of European art. L'architettura moderna non è quella cosa che credono cinicamente agli americani: "the engineering solution of the building problem." Non è lo standard di Le Corbusier, o le sozialen Fragen di Taut. Il suo destino, la sua profezia, è il rivendicare la fondamentale libertà dello spirito." E. Persico, Torino, 1935.*

*Note 10. Vittorio Gregotti, "The territory of architecture", 1972 (1966)  
"We have thus arrived at an idea that seems central to our way of thinking about design: to be the structure of the design of a fundamentally formal nature; every other aspect (stylistic, ideological, technical, economic) is only material, even if it is a particularly orientating material".*

*Note 11. The reconstruction/recognition a posteriori presupposes a given truth, the finding of an authentic origin, the primary value. But, as Tafuri writes, "Michel Foucault has already contrasted this childish desire to discover the murderer with a story formulated as genealogy".*

*M. Tafuri, "The Sphere and the Labyrinth", op.cit.*

*Note 12. With the exclusion, perhaps, of the marketable image, such as that sought for promotional purposes by companies, which pursues different and contingent purposes, and refers to the imagery created ad hoc.*

*Note 13. Herbert A. Simon, "The sciences of the artificial", Isedi 1973 (1969).  
"When we come to the design of complex systems such as cities, buildings or economic systems we have to renounce to create systems that optimize the function of utility hypothesized and see if the differences in style ... are not extremely desirable variables in the design process, rather than alternatives to be evaluated as better or worse. Variety, if it remains within satisfactory limitations, can be a desirable goal in itself, among other things because it allows us to value the research and its result; to consider the design process itself as an activity that has a value for those who participate in it.*

*Note 14. Paul K. Feyerabend "Against the Method" Feltrinelli 1979 (1975)  
"Therefore, the invention of alternatives to the opinion in question is an essential part of the empirical method. Conversely, the fact that the condition of coherence eliminates possible alternative theories now shows us that it disagrees not only with*

*scientific practice but also with empiricism" and later: "In this way, the condition of coherence will finally create a situation in which a certain point of view will be petrified in dogma for having been completely subtracted, in the name of experience, from any conceivable criticism".*

*Note 15. In a table by Simone Martini, for example, it is possible to find possible simultaneous stories of reading an urban image, from the outside and, through the entrance, from the inside, encoding possible and plausible codes of perspective deformations. And these deformations are therefore not "errors", but possible answers to a multitemporal vision of the environment. C. Soddu, "L'immagine non euclidea", Gangemi Ed. 1987*

*Note 16. Jean-Francois Lyotard, "Intervento Italiano", Alphabet No 32, 1982.  
"I read that, under the name of postmodernism, architects get rid of the Bauhaus project, throwing away the child, the experimentation, along with the functionalist bathwater."*

*"What is it, then, postmodernism? ... Extraordinary acceleration, generations fall. Work cannot become modern unless it is first and foremost postmodern. Postmodernism in this way is not modernism that has come to an end, but modernism in its nascent state and this state is constant"... "The grammar and vocabulary of the literary language are no longer accepted as data, they appear rather as academicisms, rituals derived from piety (as Nietzsche said), which prevent the unrepresentable from being called into question. Here, then, is the dispute: modern aesthetics is an aesthetic of the sublime, but nostalgic; it allows the unrepresentable to be evoked only as an absent content, but the form, thanks to its recognizable consistency, continues to offer the reader or observer matter of consolation and pleasure. Now, these feelings do not constitute the authentic sublime sentiment, which is an intrinsic combination of pleasure and pain: the pleasure that reason exceeds any presentation, the pain that imagination or sensitivity is not up to the concept. Postmodernism would be that which in modern times calls into question the presentation itself; that which refuses the consolation of good forms, the consent of a taste that would allow us to feel in common the nostalgia for the impossible; that which goes in search of new presentations, not to enjoy them, but to make us feel better that there is something unrepresentable".*

*Note 17. The explicit reference is to the works of Michel Focault.*

*Note 18. Heraclitus, "Fragments"  
"What contrasts and by elements that disagree one has the most beautiful harmony."*

## **DESIGNING THE NATURAL/ARTIFICIAL**

designing the environment



*[1] From Cocoon forth a Butterfly  
A Lady from her Door Emerged - a Summer Afternoon - Repairing Everywhere  
Without Design -that I could trace  
Except to stray abroad On Miscellaneous Enterprise The Clovers - understood -*

*Emily Dickinson*

Designing the natural. If the natural is considered as opposed to the artificial, this project is almost a contradiction in terms. The natural could not be designed, because designing presupposes the artifice, the artifact, the transformation made by the man on nature in order to dominate it, to modify it according to its needs.

From another point of view, if we reduce the meaning of nature to the concept of green, and as such to an element connected to our needs, designing the natural becomes synonymous with deciding how to plow the field, or, at a more sophisticated level, is expressed in the art of gardens, then in a classic project of artificial environment in which the natural "material" is used.

Still today, for many designers, there is this alternative structure of possible approaches, and the natural is either seen as an antagonist of their own design work or is identified as a "material" for the construction of categorically artificial environments.

If all this was true until a few years ago, the problem is now being tackled differently, starting with genetic design, the results of which straddle nature and artifice.

In areas such as biology has come to the need to verify the ethical implications of these designs. But in sectors where manipulations of natural evolution have already been taking place for millennia, such as the natural environment transformed by the man with agriculture and cities, the morphogenetic/evolutionary approach leads to a greater awareness of the transformation processes that have occurred, are taking place and are possible.

This has led to consider possible, first experimentally and then also operationally, an approach that excludes the a priori existence of the dichotomy between natural and artificial. The two worlds may not be opposed; on the contrary, they appear as facets of the same evolutionary dynamics, which can ultimately be tackled using the same operational logic.

Let us consider the two systems, the natural and the artificial, and their evolutionary processes. Each of these worlds pursues, in its evolution, a common goal: the increase of complexity [2]. Natural environments acquire complexity through genetic evolution; natural species evolve by accumulating increasing potential for self-control and adaptability to the context in which they live. Cities grow over time acquiring formal and functional complexity, the same architectural projects, as they evolve, acquire the ability to respond to multiple needs and requirements. In the industrial object, the series of successive versions activates transformations, morphogenetic sequences that are conceptually similar to the evolution of natural species.

These evolutions take place through iteratively repeated sequences of bifurcation moments, of subjective/casual choices whose results are not definitive but are immediately proposed, in the next cycle, as a basis for further requests, for new increases in response capacity and complexity.

If the artificial evolves through subjective choices and the natural through random choices, this does not define a watershed, as both subjectivity and randomness affect evolution as they produce a change that, in subsequent cycles, may prove appropriate to the solution of the needs of individuals. If we think that the subjective gesture of a designer is more conscious and pertinent than a random event, this does not change the logic at all, only the timing of its application. A project is realized (and acquires complexity) in much less time than the evolution of a city, but the latter is much faster than the evolution of a natural species.

What differentiates the evolutionary processes of nature from those of the artificial, and which up until recent years appeared to be a difference that is difficult to overcome, can be transformed (with the current elaboration/simulation tools available) into a simple diversity of operating modes.

In the artificial, the evolutionary process tends to reduce cycles and increase complexity, acting in parallel and simultaneously on several fronts (think of the interdisciplinary complexity of a building project, or of the variation of the models of a car that simultaneously considers all the aspects of a total quality), while in the natural world the increase in complexity arises, on the contrary, from the repetition for periods of time normally very long, even millions of years, of formalization cycles that are instead structurally quite simple and linked to chance [3] as can be verified by the traces of evolution from simple life forms to complex models.

The underlying dynamic process is identical, however, and the result is always an increase in complexity. The natural is different because it tends to amplify the serial aspect, the infinite repetition, the artificial because it tends to reduce the number of cycles and operate in parallel on various planes.

If we provide ourselves with instruments that can continuously and quickly re-propose the same logical procedure of choice in a cycle that repeats itself, the wall of opposition between design and nature begins to crack, if not to break down completely

and progressively disappear.

Surely the instrument that accelerates the destruction of this boundary is the computer that, paradoxically, has an operative structure that can simulate nature very closely: it can operate for successive iterations, tending to infinity, of extremely simple operations. It, therefore, makes it possible to organize, and operate, design sequences of a serial type, similar to the structure of the evolution of a natural species.

Through this tool, the project has the possibility to configure itself as a genetic code of formalization, a logical designed DNA that operates by repeating the same procedures over a large number of successive cycles through which it comes to produce complexity. That is, it reaches its objectives not through a few extremely complex cycles (which until now have characterized the "project"), but through small successive accumulations, such as nature, making small [4] choices and proposing them again, in the next cycle, as requests to which, with the same logic, it responds with small choices, and so on until the desired complexity is reached.

The use of the computer, in fact, provides us with a possibility unthinkable for a human operator: the fast repetition, without boredom or fatigue, of the same procedure countless times, operating on a material that is constantly renewed, growing in complexity with each cycle.

The project, therefore, can become a procedure (in mathematical terms an algorithm) that does not define (like the old artificial project that was opposed to the natural one) an equilibrium, a unique result, but the same structure of becoming. A structure capable of simulating a set of final scenarios, all different, because contaminated by contingency, but all characterized in a species. So the results cannot be univocal. As in nature, each individual is different from all the others, even if he is identifiable in a species. Every event produced will be surprising and unexpected, because it is unpredictable as an individual, but it responds to needs and their complexity, as a species.

The result of the conventional project is, in fact, univocal, strong and desired, but categorical and labile at the same time for its intrinsic inability to adapt and evolve over time. The result of a project/procedure, on the other hand, designally defines the imbalance itself, the evolutionary code of the system, and to do so generates a virtual map of the evolutionary process and allows both control and adaptability.

This code, therefore, becomes the key, characterizing, to reach and control the complexity of even extremely vast systems, and then operate proactively in order to obtain comprehensive answers to the increasingly complex and evolving needs.

The project that operates on evolutionary codes, moreover, produces the highest quality in an event/individual when it develops its path through sequences of unforeseen requests. The impervious structure of the path generates, in fact, an increase in complexity, as the difficulties are used as opportunities to fully explain the design/evolutionary logic of which it is composed. Like nature, where the improvement of the species (improvement understood as an increase in complexity of the tools for multiple responses to needs) is a direct function of the randomness and complexity of the environmental context in which the species finds itself living.

And also this aspect proposes parallelism between project and nature. Like nature, the artificial is all the richer, more complete, more interesting and more responsive to expectations the more problems the designer has had to face; or rather the more problematic aspects, or even events and subjective and random requests the designer has been able not to suffer, but to transform into occasions of formal growth, of increase in meaning, of design "evolution".

All this re-poses the theme of the context in a key that explicitly involves the logical procedures of design. And it brings together, in a single conceptual approach,

different problems and occasions: the relationship between an architecture and the physical context of reference; the cultural and intersubjective context that, as it evolves, accompanies the design as a universe of possible requests; the context as a key to understanding the meaning of the choices of formalization; the context as an evolving structure capable of creating unexpected, and sometimes unexpected and fruitful resonances with the evolutionary dynamics of our design discovery; and finally the possible clarification of an individual interpretative approach to one's own subjective imagination, as a measure and context of reference for a qualitative evaluation of the real/virtual designed.

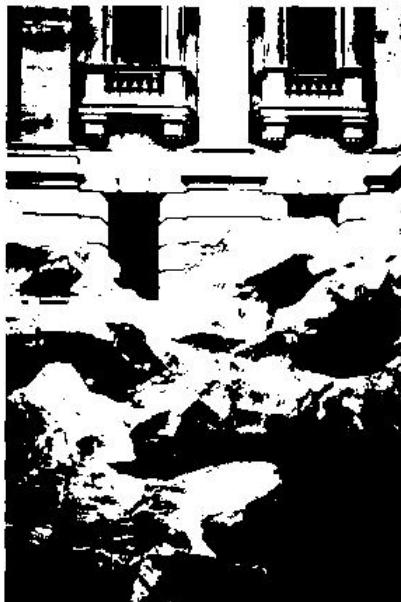
*Note 1. [In the summer afternoon / from the cocoon emerged a butterfly, / As a lady from her door, / And from everything for everything went on and on / O goal that I could imagine, / If not the goal of distant journeys / And multiformal enterprises / That clovers understood]*

*Note 2. Gregoire Nicolis Ilya Prigogine, "The Complexity", Einaudi 1991 (1987). "In fact, since the 1960s we have witnessed a revolution in both the mathematical and physical sciences, imposing a new attitude in the description of nature. Parallel developments in the thermodynamic theory of irreversible phenomena, in the theory of dynamic systems and in classical mechanics, have finally come together to show conclusively that the gap between simple and complex, between order and 'disorder, is much more subtle than previously assumed".*

*Note 3. J. Monod, "Il Caso e la Necessità", Mondadori 1970.*

*Note 4. Renè Thom, "Structural stability and morphogenesis", Einaudi 1980  
"... It is conceivable that the DNA exerts a directing action on the metabolism without the intervention of really important interaction energy; in catastrophic situations, in fact, a very weak variation of the initial conditions can determine great changes in the final state..."*

## **DESIGNING THE EVOLVING ENVIRONMENT**



*"Fiorivano in mezzo alle piazze lievi e stupendi i segni della vita  
che per altri ragioni un poco pazze erano ancora inutili alla vita"*  
Sandro Penna

In light of these possible approaches to design, we need to rethink ways of tackling the problems related to the overall quality of the environment in which we live. The environment is, in fact, a complex, evolving system, and it is unthinkable, reductive and not sufficiently reliable to address its problems on the basis of static assessments that do not take into account the dynamics of growth and transformation, in other words, the very life of the environment.

The tools we have at our disposal are only changing completely compared to a few years ago, and the framework and operational logic within which we need to operate if we want to tackle an environmental problem in a project.

In fact, we no longer have an alibi to operate in the analytical-mind project, identifying hypothetical and unrealistic equilibriums, since the state of equilibrium, as a state of reference, is now part of obsolete scientism. Operating by designing an imbalance, an evolutionary logic directly as a dynamic system in transformation appears, on the contrary, the most correct approach towards an environment whose naturalness and complexity in evolution are the real heritage to be preserved, not forgetting, in this complexity, the historical/cultural and image component, which is also in evolution.

Even these last two aspects, linked to our history, cannot, in fact, be closed in evaluations and analyses of factual states, frozen in static museum models, on pain of the destruction of the active cultural heritage itself. We, therefore, realize that a direct approach to the dynamics of transformation of the environment can be operated, with identical interest and success, not only on the natural but also on what we consider as the very image of the artificial: the city.

A historical city, or at least a natural/artificial environment with a complex and long evolution behind it, is in fact very similar, conceptually and formally, to a natural environment. [3] First of all because of its complexity, which is comparable to the complexity, for example, of a natural park. The first verification we can have if we try to draw an imaginary forest and city. Both the metropolitan and the natural scenery will appear, in any "fantasy" representation that will be attempted, too simplified, I dare say "artifacts". They lack, in the same way, complexity and naturalness. That complexity/naturality that is given only by history, by countless cycles through which the same evolutionary logic has been repeated on different occasions.

If we cannot draw them directly, however, we can draw them using computers and algorithms; generating complexity through the simulation of the same evolutionary path followed by the city or the nature of a park, through the continuous and indefinitely repeated iteration of logical cycles identical but linked, each time, to contingent, random, different realities.

This path is what we have tried in our experimentations, and that we have verified operationally through some species projects.

The instruments. In order to operate on a complex environmental system, with multiple integrations between historical architectural stratifications and nature, it is appropriate to develop an instrument that allows, first of all, to respect the complexity, and to control the current and hypothetical evolution.

Given the premises, the starting point is to structure a dynamic model of the environmental system such that it can be the basis of the evolutionary project.

Such a model is presented, in the research and experiments carried out, as a model/system in which all the elements are dynamically represented through evolutionary sub-models. In other words, all the formal entities present in the territory, from buildings to trees, from groups of buildings to forests, are identified in their evolutionary structure, in their degree and character of transformability, read in the light of the evolutions that have occurred and are in progress.

A tree, a forest, a settlement, which are transformed following extremely different logics and causalities, will be told in terms of formal logic. This is because in order to act through the complex network of interrelationships between events, in the very dynamics of their development, it is essential to use a single code of reading and control, even if the individual events belong, and are causally readable, through different disciplines. [4]

The tool capable of operationally closing these connections is the formal logic, which does not depend on cause/effect evaluations, on evaluations linked to the why of the events, but only on the how, on the evolution of the form of the event, with all the connected multilaterals.

With formal logic it is possible, through algorithms that represent its morphogenesis, to tell simultaneously and compare a tree and a city.

But these algorithms, it is good to specify it, can never represent, for example, an individual/tree; from the individual one can arrive, interpreting the evolutionary codes, to the algorithm. From the algorithm we will never be able to arrive at that individual, if not randomly; but we will arrive however to something much more useful: to the possibility to generate a universe of always different individuals, a universe of trees, in our example,

that, despite their mutual difference, will always be identifiable in a species, in a genetic code, and in its algorithmic representation.

Let's see in more detail how these dynamic models/representations realize our operational tool for the environment. And how, even though they are subjective and tendentious like all representations, they can become reliable working tools. The subjectivity of the approach, precisely because of its specific tendentious/casual interpretation, offers on the contrary two valid opportunities to reach some quality objectives that we can identify with the ability to respond in a relevant and flexible way to the changing needs of human life.

On the one hand, in fact, the subjectivity of representation, if repeated several times in different contingencies, makes it possible to read, and fine-tune in advance with respect to the design, the multilateral structure of the possible connections and interrelationships between environmental context and imaginary reference, which will build quality. Secondly, it allows recalibrating, through the elimination of categorical detritus, one's subjective approach. The congruity between the dynamics interpreted (and then simulated) in sequences of virtual scenarios, and the dynamics emerging from the evolutions actually occurred in the past, will improve as the experimentation proceeds. The initial models will be highly subjective, but if algorithms and parameters will be recalibrated experimentally through sequences of successive simulations, the adoptable model, although the result of interpretation, will have a strong plausibility and operational effectiveness. In fact, it is not necessary that it responds to the truth, it must only possess evolutionary modalities similar to the reference.

To realize this tool, first of all, we must reconstruct/represent the formal genetic code of the single elements present in the reference context, or hypothesized in the future.

But every element is not necessarily easily identifiable in an individual/event. We can, for example, consider as an individual/event a single tree, or the forest, or even an entire valley. As the scientific results of the last few years have taught us, it is possible to consider as an individual everything that presents itself with self-regulation and self-organization skills [5]. In the artificial, we could consider as individuals an object, a building, or an entire city.

In order to operate, however, we must (subjectively, on presumed plausibility) define some elements/individuals at the various scales, and tell their evolutionary characters through the explanation of how this happens; identify the *genius loci* [6] of particular places recurring in the territory, define their formalization and topological characters and produce a reliable morphogenetic code, whose use reproduces, operating on the present elements, the same environmental image. All this experimentally, refining for successive approaches the logical procedures represented so that the evolution we are analyzing in the real coincides, more and more, with the simulated virtual evolution. Or rather, that the virtual scenarios that are simulated are, in their reciprocal diversity, ever closer to the imaginary reference adopted, to the post-metaphysical idea that we have built of the species.

In the experiments that we have carried out in recent years, for example, the typical medieval village, whose image was taken from the recurring characteristics of fourteenth-century paintings, has been taken into consideration as a species, and, on a different scale as a subspecies with its own evolutionary logic, the square and the open spaces that were also born in connection with exceptional events in the "history" of urban growth; on another scale, the shape of the buildings and that of the natural structure, from greenery to individual trees.

All this material, translated into morphogenetic codes, becomes part of a species project which, through further algorithms aimed at the complete construction of a

dynamic system of unpredictable evolution, makes it possible to generate individuals/environment always different, absolutely unpredictable, but always identifiable with the reference environment. In the case of the medieval city, this environment always turned out to be, despite the individual differences, a village made of streets, towers, squares born as spaces of respect towards important buildings, and of greenery that integrates with the built-up with recurring relationships of interaction because triggered by the same compositional/evolutionary logic, but then diversified by the specific bifurcations of each of these parallel virtual stories. Events that possess, of course, the same structures of the relationship between the parts, the same symbolic sequences even if each time filled with contingent forms. the same symbolic sequences even if, each time filled with contingent forms.

The three-dimensional models that each species project [7] produces do not have to be evaluated individually, even if each one closes the genetic code created in the individual, and can be visited virtually, through internal walks simulated with the computer. The three-dimensional models of virtual cities that the project produces must be considered as a whole, as a universe of possible scenarios of development of the environment to which the project refers.

And if we, with this operational tool, stop the simulated time before the fixed term, we would have a set of environmental models all different, but still "young", and less complex, since the simulated history has not yet managed to strongly characterize, as it happens in real environments (artificial and/or natural) with millennia of "history" the individual image of the place.

But we cannot limit ourselves to dynamically analyzing only objects, spaces, shapes; that is, everything we have identified as an individual/event. If our project aims at reconstructing the morphogenetic code of a complex environment, we cannot underestimate the topological characters of places, the recurrence of sequences characterizing individual events. Therefore, the procedures of formalization of the interfaces between spaces/objects/individuals become absolutely indispensable elements of elaboration. It is enough to think of the sequences, interconnections, and interfaces along virtual "sections" of possible forms of the environment, whose character must be translated into formal logic in order to obtain topological parameters of control and proposition of morphogenesis. And this above all because one of the objectives is to take into account the quality connected to the image which, in order to maintain itself over time, must proceed dynamically in its own development interacting with life and needs which are also growing and changing [8].

A particular indication should be given, in the construction both of the dynamic model and, then, of the "project" itself, the presence, and possibly the possibility of future birth/growth, of exceptional events, i.e. those events that have the possibility to interact directly with the total quality of the environment.

The presence of exceptions is indispensable to the quality of any environment, natural or artificial, and in particular to its components of complexity and information capacity. Each exception, in fact, provides a further key to interpreting the environment itself and accelerates the process of development.[9] Each of these readings, moreover, is not only different from any other but, stratifying over and not replacing the previous readings, determines an increase in total complexity, an increase in the ability to respond to the needs related to the quality of life.

The willingness to accept exceptions must be provided by the dynamic model of environmental morphogenesis, and can also be designed statistically. Such willingness is a characterizing element in the image (and structure) of any environmental system.[10]

Once the events structuring the system have been represented with morphogenetic

codes, they must be reported within an overall evolutionary project, which is then a specific software dedicated to the particular environmental situation on which it is intended to operate. Each event, represented with its intrinsic evolutionary logic, must be able to interact with the design logic to be activated. This logic, which is also formally represented, operates by structuring the evolutionary dynamics of the form, through repeated cycles of simulated choices.

As a logic, as a post-metaphysical project of procedure towards a reference imaginary, the activated formalization mechanism always behaves in the same way with respect to the contingent that varies, and the unpredictability produced by the resonance between the evolutionary logic of the single events.

Every result is unpredictable. But not because it is the result of a random process. The logical itinerary is always the same, and moreover strongly characterized. In every virtual story that is simulated, the morphogenetic structure typical of all design processes is activated, but with an extra element that brings it closer to natural evolution. The result of each cycle, i.e. the formalization of a choice made on a request, is not only reused as a request in the next cycle (as it normally happens in designing), but the operation is repeated infinitely, or at least for a considerable number of times, as many times as the "length" of the story to be simulated requires.

This iteration places artificial and natural evolution under the same control parameters. And it brings back to the same instruments of verification the subjectivity in the design choice of single forms and the randomness of possible events in the natural. Both, in fact, fill the interstices of randomness necessarily present in every choice, as the difference between requests and formalized responses. If the incidence of this, at the beginning of the process, appears almost irrelevant on the overall result, the succession of cycles can amplify its incidence so much as to condition the very recognizability of the final shape of the environment.

*Nota 1. S. Penna, "Stranezze", Garzanti 1976*

*Severino, "Legge e caso", Adelphi 1979*

*Nota 2. Emanuele  
"To truly dominate the becoming it is therefore necessary to dissolve the spell of the immutable, the dream within which one dominates only because one has turned one's back on what one intends to dominate".*

*Nota 3. Georg Simmel "Roma" 1898, in "Metropolis" M. Cacciari, □Officina 1973.  
"One element is beautiful only in relation to the other, and the latter only in relation to the first. Beauty belongs to all these elements, and yet to none.*

*We recognize these extraordinary relationships when we contemplate nature, whose mechanical randomness can give both beautiful and ugly form to its elements, or when we contemplate a work of art that produces the same effect through a conscious search for beauty. But there may also be a third, very rare case. It may be that human works, created for the satisfaction of some need in life, reach the form of beauty in a manner as random and unconscious as the products of nature. It is almost only the old cities, grown-up without a conscious plan, that offer such content to the aesthetic form..... The same happy case that has formed according to our aesthetic needs the lines of the mountains, the colors of the sea, the interweaving of the trees, reappears and is confirmed in the old cities...*

*In the image of the city of Rome, this happy case has reached its highest charm...[which] arises precisely from this wide and yet reconciled detachment between the randomness of the parts and the aesthetic meaning of the whole".*

*Nota 4. R. Thom, op.cit.*

*Nota 5. I. Prigogine, "La complessità", op.cit.*

*Nota 6. Christian Norberg-Schultz, "Genius Loci, Paesaggio, Ambiente, architettura", Electa 1979*

*For a definition of the genius loci that in any case takes into account the impossibility of disregarding the evolutionary dynamics of the environment, and when it proposes the use of "constants" it means them as relations, therefore parameters of reading/appreciation of becoming.*

*"To better know the genius loci we have proposed the concepts of meaning and structure. ... Both can be considered abstractions derived from the flow of phenomena, not in the sense of scientific classifications, but as direct verifications of "constants", i.e. stable relations that emerge from events of a transitory nature".*

*Note 7. Concretely, the species project is an original software, written ad hoc for each species like the tables of an "individual" project.*

*Note 8. If, for example, we want to operate with the aim of triggering a progressive accentuation of the formal characters present in the environment under examination, we can also think of an extension of the enjoyability of these events (modal expansion, the usability of which can also be extended to less gifted people, the disabled).*

*A procedure of this kind, therefore a project that foresees the subsequent accentuation of the formal characters (making the enjoyability intermodal, therefore, for example, operating through music or with tactile and olfactory messages to communicate formal events to the blind), must be defined within the same growth/evolution of the environment and its characters, and not only identified as a ploy to solve contingent situations.*

*Nota 9. Emanuele Severino, "Legge e caso", Adelphi 1979*

*"In the construction of formal systems the contradiction is explicitly recognized in its character of radical unpredictability', that is as something whose appearance cannot be excluded a priori from the apparent coherence between the rules of formation and transformation of the formalized axiomatic system... It is not only in relation to the theoretical apparatus of empirical science that the absolute unpredictability of the event introduces contradiction into theory; also the theoretical apparatus of logical-mathematical formalisms is open to the irruption of the conceptual event that determines the contradiction of formalism.*

*Note 10. The presence of too many exceptions can create the impossibility for the user to identify reliable reading codes and references, and therefore a difficulty of information; the lack of exceptions can lead to the same negative result, to the impoverishment of the information, and therefore to the lowering of the quality level of the expected answers.*

## THE DESIGN OF MORPHOGENESIS

*The species of the artificial.*



*"Because cicadas used to be men. They stopped eating, drinking and loving, so they could sing non-stop. Taking refuge in singing, they became drier and smaller, and now they sing, lost behind their nostalgia - bewitched, but also damned because their voices have become inhumane".*

Ingeborg Bachmann, "Der gute Gott von Manhattan" "

The starting operational hypothesis was to directly correlate the species of belonging of an event/individual with the evolutionary/project logic that generated it. In other words, to relate some recurrent characteristics of quality and complexity with the dynamics, modalities, and procedures that generated the individual/event.

If we then extend this approach transversally from the artificial to the natural, we find the meaning and objectives of our experimentation. The correlation identified leads to define comparable the recognizability of a natural individual as belonging to a species and the recognizability of an artificial event, of a project, as belonging to a specific operative logic, to a productive philosophy or, more generally, to a subjective (or post-meta-project) meta-project. A post-metaphysical program, an idea that designs "a" world.[1]

Natural and artificial species are therefore defined by the procedure that generates the individuals, by the genetic code/project that manages the random/contingent component of their evolution. An evolution that, as it has been treated in the previous chapters, is, both in the natural and in the artificial, a shift towards complexity. These procedures are, on the other hand, the most explicit and less redundant representation of these complex structures, since they replace the description of the process with the

cataloging of all the infinite and possible contingent states. [2]

The purpose of this work was not, therefore, to automate the design, or to create software that could replace man in this proactive activity. The main objective was to understand the limits and ways in which a design approach is made explicit. And to identify the fields of pertinence and interference, in the development of an artificial system, of all the components that are put into play. In particular, the role that the formal matrices used and the procedures activated assume, respectively.

How shapes are chosen, and how they are transformed, has always been the problematic node of design, and the consolidated modus operandi of design is built on it.

But all this has never been the object of targeted experimentation, of simulation through which every parameter put into play could be enucleated, and then evaluated in all its potential interference in the progressive development of the idea.

This is, therefore, an experimentation parallel to the one currently implemented in other disciplines, using the most current tools, and based on the simulation not of states of fact but of evolutionary dynamics. It is an experimentation that rediscovers the pre-modern scientific approach as it does not tend towards the unifying definition of truth but towards the knowledge of the complexity and multi-laterality of the multiple and unpredictable ways that the field under examination can assume to make itself explicit. The objective is the discovery of the morphogenetic modalities of the becoming of the artificial. A discovery that can only be experienced through the activation of a series of parallel simulations. The results, only in their diversity, can be able to highlight not the quality of a single event, but the quality of the process. Which coincides, according to the proposed correlation hypothesis, with the quality of the species.

If applied to the natural/artificial environment, this experimentation must be able to lay the foundations to evaluate not a single possible arrangement, but the same evolutionary line triggered by the project, the idea as a way to reach the collective imagination. For architecture, this experimentation aims to reach awareness, on the part of the designer, not of the quality of one of his works, more or less "guessed", but of his own way of designing, of his creative approach to the environment.

In industrial objects, the activation of this experimentation, in addition to the verification of the design approach, opens an unusual field and responds to the current demand for varied and personalized series: the repeated simulation of the logical process of design becomes itself a project, the project of morphogenesis. And this project defines not the individual, but the species itself.

Thus was born the project of genetic codes of the artificial that with the current production technologies can be used to directly realize the unique industrial object. No longer a repeated object but an individual object, always different and at the same time recognizable by its design matrix.

From the environment to the object, however, the operational approach has been similar. In order to represent the compositional logic as a genetic code, therefore as a contingent management procedure, we have used the possibility, reached in these years, to mathematically transcribe [3] this procedure (or better each of these subjective procedures) as a dynamic system with unpredictable development [4], defining its operating modes and designing for each of them a specific software able to simulate its development. All this experimentally, thus entrusting the verification directly to the control of the results that were gradually generated.

The correspondence of the results to the objective to be achieved was always analyzed on a very high number of simulated virtual outcomes and measured through the recognizability of the result obtained in the compositional DNA that was intended to be

built.

Every time a set of virtual events was evaluated, progressive adjustments were made in the algorithms used. These "corrections" tended to bring the generated scenario closer, in the generation of events subsequently simulated, to the reference imaginary. But they were not, except in very rare cases, corrections. The approach has always been that of "successive contributions", of accumulation of possible procedures, of refracting the recurrence of a too categorical and reductive outcome in a multiplicity of successive complexities which, through the same evolutionary process, eliminated the "error" understood as detritus of categoricity. The hypothesis that was pursued, in fact, is that there is no such thing as a design error, there is only an evolution stopped too early when the impossibility of opening subjectively or randomly made choices to intersubjectivity still survives. In the project, the subjective alterations of reality must be able to be subsequently altered, falsified by the hypothetical observer. To achieve this it is necessary to increase complexity as a prerequisite for a possible subjective ambiguity. [5]

Therefore, for each project, a work of immersion in the most hidden details of the logical procedure that was being built was carried out, immediately verifying its ability to trigger further developments. A try and try again, modifying parameters and implementing procedures, possible processes of image construction to verify how these variables affected, in the majority of the results obtained from the simulation, the ability of the project to bring the virtual environment closer to the quality objectives hypothesized. It was, therefore, creative work to increase the probability that the desired quality would happen. But it was also a verification of the negative interactions between possible modifications of the procedure and impoverishment of the results.

But, as in all human activities, and especially in design activities, the objectives to be achieved become more and more complex and sophisticated, acquiring connotations of possible quality as the work progresses. The imaginary reference that we possess at the beginning of a design path feeds on the same project, grows by building further possible worlds on the ashes of the already experienced, on the trace of the forms generated.

In a morphogenesis design, this is enhanced. Being able to experience immediately and in progress the countless facets of one's own idea through the extemporaneous generation of parallel virtual scenarios, allows one to increase one's own imaginary reference by accelerating the explanation both of the same latent potentialities and of the possible categoricity and reductiveness present in the design idea.

The morphogenesis design, therefore, is realized with the same modus operandi of the project of a single event. The objective changes: instead of designing the individual, the species is designed. The simulation tools of the possible scenarios allow collimating, for successive approximations, the project to the imaginary as it normally happens in designing. Only that in the usual design the event is simulated in its uniqueness, and its possible variations are verified with the design; in the morphogenesis project the species is simulated in its multiplaterality of possible individuals, and the probability that every possible individual, in its diversity, is born with the desired qualities for the species is verified with the dynamic simulation of parallel stories. In this it is decidedly different from the "meta-project" of the sixties: a morphogenesis project is implemented empirically, through small steps of successive experiences, following its own subjectivity but experimentally verifying that it proceeds towards multiple, complex and intersubjective capacities of response.

The theme, the constraints, and the context. The morphogenesis project works on becoming. In order to implement it, it is necessary that also the operational field (the environmental context, the demands, and constraints) can be represented in a relevant way by a space-time model [6] that simulates the imbalance of the system. This is both because the environment is identified and characterized by its own evolutionary dynamics,

and because of the very necessity of the project and the existence of requests presupposes an unbalanced structure. The design act, therefore, is not seen as a transformation with the objective of balancing the environmental context, but as a transfer of the initial imbalance to a more sophisticated level, as an increase in complexity of the evolutionary dynamic itself.

Every single object designed is not a final answer to a request (the fork to take the food, the door to enter, etc.) but a man-environment interface that changes, bringing it to a higher level of complexity, the stratified structure of the relationship system that supports the qualitative evolution. The design logic becomes a device that works on the requests to satisfy them. But device and requests are both in transformation: design logic accumulates experience and adapts, requests grow on themselves and progressively shift towards more complex and sophisticated fields. If we read the evolution of the environment as a cyclical demand/response process, the design processes, and the same compositional/evolutionary logic that underlies them, increase the same demand for design. The system is self-feeding and does not tend to extinguish the imbalance, on pain of death/museification of the environment. The design activity tends to the possible environmental quality, and therefore to the reduction of the differential reality/image. The environment, in its evolution, does not reduce this differential but moves it progressively.

Every result achieved in raising the quality of the real environment translates into the simultaneous raising of the quality possible.

The hypothesis on which we intend to operate is that the design process activated, once all the programmed requests have been satisfied, has produced more requests than it has at the same time fulfilled, thus accelerating the evolutionary process.

This acceleration corresponds to the very substance of design, in which each act operates on incoming requests, even totally satisfying them, but the same form used in the formalization of the needs exceeds the field of the pertinence of the same, producing at the same time further requests.

In the morphogenesis design, this required cycle - formalized response - the transformation of the form into further requests is simulated, and this simulation can be repeated an unlimited number of times.

Due to this kind of dynamic approach, the design themes, and their constraints/requests, cannot be represented statically. But that's not all. Since the logical process operates on the transformation of requests into forms and on their retransformation into requests, the constraints must be translated into formal logic. In other words, every basic request of the project, which can be formulated initially in the language and terms of the relevant disciplines (construction science, economics, technology, typology and functional/distributive specifications, ergonomics, etc.) must be translated into forms and procedures for their transformation.

To give a trivial but explicit example, the specific disciplinary requirements of structural calculation applied to a beam must be translated into certain forms and the dynamics of variation of the same as the span or weight increased. A variation that can be dimensional (increases thickness) but also formal (from full beam to reticular beam) and material. Once identified, and assumed as a reference matrix this dynamics of transformation of the form on itself, it is no longer necessary to go back to the causal processes that determined it. From a plan of disciplinary references that investigated why we have moved on to a more direct plan of use for design: the identification and use as the material of the design of how it happens.

This, after all, is the architect's modus operandi. In tracing the shape of a building, he takes into account a whole series of different factors but, at the time of the choice, he acts only on the shape, being aware, simultaneously, of the plausibility of the same on the

technical construction, economic, etc.. The specific work of contingent refinement in the various disciplinary fields is carried out a posteriori, as a verification.

The initial constraints of the project will then have to be translated into form transformation procedures if ... other forms happen. And identifying, in parallel, among the possible options, the interchangeable ones; and defining, among these, the hierarchically preferred one.

But all this is already a project. These preliminaries of the morphogenesis project are already subjective formalization of requests, subjective options on forms responding to one's conceptual needs, construction of beauty as dilation of the real in a process of possible references [7].

These subjective choices, in order to approach an intersubjective quality, must leave the sphere of the categorical gesture and find themselves as an initial "weak" gesture [8], capable of catalyzing the progression of the project. The basic procedures that dynamically trace the overall picture of the constraints imposed by the theme and the context will, therefore, have to be experimented and eventually expanded, transformed, increased in specific parameters following the flow of possible simulations.

A number of special considerations need to be made with regard to the analysis and acquisition of the environmental context. Representing a complex environment through the reconstruction of a universe of increasingly interconnected simultaneous evolutionary systems is extremely difficult, especially if one tends to produce intersubjective readings. In reality, intersubjective plausibility is not, at first, necessary. If the implemented representation has some strongly tendentious and subjective margins, this does not take anything away from its usability and relevance. The reconstruction, like any reading of the context that is implemented in the usual design modus operandi, is the key, the identification of the starting point of the operational proposal on the existing environment. The fact that the paradigm used for the reading of the context is subjective creates the premises for an increase in the complexity of the environment and for an increase in its total quality. The project that is being elaborated, in fact, will stratify a further possible chain of meaning, a further adaptive capacity and response to the unpredictable possible subjective demands.

Construction of the compositional logic.

The dynamic evolutionary system that represents the design logic is structured with the same formal logic language with which we have transcribed the constraints and the environmental context of reference, but with a different objective: the construction of compositional recognizability, an identity of species.

The objectives are essentially two:

1. the construction of an evolutionary structure capable of responding, in progress, to the conceptual needs of the designer himself,

2. a dynamic of progressive acquisition of complexity that simultaneously favors the growth of adaptive capacity and response of the project and the progressive shift of the subjective categoricity of the first gesture towards a possibility of intersubjective appreciation.

In other words, morphogenetic procedures have to be activated that make the project grow in terms of complexity and compositional recognizability, and at the same time, they purify it from the categorical and short-sighted nature of a strongly subjective vision that would affect the possibility of being generally appreciated.

To achieve this, the morphogenesis projects we have created operate by generating forms and defining procedures. The forms are generated by devices that simulate contingency/casuality/subjectivity. The procedures operate through successive cycles within which, progressively, the subjective/casual forms, the formal "gestures" are transformed. Each form can take two different paths: either it becomes capable of

catalyzing the subsequent processes, or it is progressively reduced as an irrelevant random variant.

In the first case happens what we normally verify in the usual way of designing. We draw very strong and categorical shapes, which arise directly from our conceptual needs and contingent references. These forms play an extremely particular and important role in our project: they trace a reference paradigm, they structure the field, they measure space. They behave, that is, as a catalyst in chemical processes: they favor the realization of the chemical reaction even if they do not participate directly in it. In our case, they create an ordered field favorable to the proliferation of forms, and they can also, once the "reaction" has been realized, evaporate as a gesture while remaining as a subjective memory of the design moment.

The other possibility is that proper to random events. If they fail to catalyze evolution in one direction, they become more and more irrelevant events, until they disappear in the development of the project.

This does not detract from the fact that they have an irreplaceable role: that of having, in any case, kept the design engine running, activated the morphogenesis procedures and if the random event was used to trigger the project, broken the spectrum of nothingness [9], of the immovable balance of the beginning of design time.

Drawing a sign, even if random [10] and destined to be subsequently eliminated, breaks the possible staticity of the system (it will "exist"), triggering development dynamics [11], progressions of complexity, orders, and disorders, but above all, marking the time of the project, and thus producing concatenated sequences of events, even irreversible ones, absolutely unpredictable design results.

Before describing how, in the morphogenesis projects we have carried out, forms are generated and procedures are structured, it is necessary to establish, and very often in different ways depending on the project theme, the respective roles of forms and procedures. As has been specified in previous chapters, the basic hypothesis was to identify the role of forms as determining the individual identity of each generated event, and procedures as characterizing the recognizability of the species. This, of course, broadly speaking. In reality, individual identity and recognizability as a species are only the opposite limits of a series of possible identifications without interruption. Just as we are used to doing with the natural world. The same forms, in their variations, are actually formal matrices, procedures and individual identity are directly derived from the contingency/causality margins that the procedure itself controls and allows.

The overall structure of the simulation device of the compositional logic makes reference to the operational structure of the natural DNA, using the materials of the artificial. It is in fact structured using the resonance [12] of a series of more circumscribed and simpler systems, each of which is linear, therefore not unpredictable in its development. The overall system, on the contrary, is unpredictable because it exalts, or better directs in function of the reference imaginary, the possible resonances among the component systems.

The basic elements, the bricks of this construction, are fluid forms. The morphogenesis project bases its operational simulation capacity on the fact that it does not use materials in equilibrium. The shapes, in fact, are not structured as a catalog or database. They are themselves formed extemporaneously by generation procedures. Each procedure is, in itself, very simple and linear, and follows, like a pendulum, a cyclic morphogenesis process. For example, a rectangle whose sides curve in a concave and convex way following the tensions of a magnetic field, or a cylinder that progressively shatters into prisms or bends until it becomes a sphere or a plane that becomes impervious according to the iterative laws of fractal forms.

This whole world of linear systems is immediately put in resonance with a universe of

systems that trace possible transformations on the dimensional plane, or that filter everything through different geometries. The basic shapes generated by the resonance of these micro-systems are already, in themselves, unpredictable. But their unpredictability does not extinguish the recurrence of specific characters that already structure the first subjective referent that is intended to simulate: the subjective/casual world of possible forms that respond to one's own conceptual needs, the language that delimits one's own world. [13]

In this world subjectivity is not given by the diversity of the forms of reference, therefore by things, but by the different procedures that can be activated to "remember" them, therefore by facts. A cylinder, for example, can be the trace of a moving circle, or the rotation of a segment around a parallel axis, or the result of a progressive doubling of the lateral faces of a prism, and so on. In morphogenesis projects, shapes will never be statically identified. The various cylinders told before are not the same, even if, at a particular moment, they can be exchanged for each other. Each one pursues its own dynamics of transformation, and it is these dynamics that identify it and defines its possible role in the compositional logic.

The primordial soup of the possible forms of one's own world of reference can be represented as a simultaneous swarming of these micro-pendulous always in transformation.

The demands of the project, in their specificity, bring out from this sea of the possible a small universe of relevant forms, which are then elaborated by procedures that simulate the logical approach. It is, in fact, the procedures that identify the compositional key.

The formal matrices chosen are in fact pertinent because, in their functional overabundance typical of the form, they are inclusive of the requests, but they are not yet the final choices. They are lowered into a paradigm (also generated with the same procedures of simulation of subjectivity) that becomes a request for transformation for the others, and this request is satisfied with transformations that in turn are proposed as requests, and so on until the end of the simulated design time. [14] In this progressive shift each form connects with the others and with the paradigm and can, alternatively, either eliminate the detritus of categoricity acquiring adaptability and short-range order or acquire strong recognizability and bring long-range order. In any case, the overall system will acquire complexity.

The form thus generated is then placed, together with the others that have been constructed simultaneously, in a paradigm at a larger scale where it retraces, at this scale and with specific procedures, a cycle of the same type. And so on.

All this, of course, leads to the unpredictability of the virtual scenario that is generated, but also to a comparability of the complexity and quality of these events as the result of different but parallel stories.

The simulations carried out with these procedures have led to satisfactory but not excessively surprising results. The basic structure of the procedures was fixed in sequences of procedures that were fixed and immovable, for example on the scale slippage level. While this was not the case when designing. This structure of simulation of the design discovery could not, in fact, trigger a real elevation/evolution of the subjective imaginary reference. They were not, in other words, an effective tool for the development of the idea. They did not produce estrangement.

The compositional logic that was simulated, in fact, was not capable of evolution during the project, it was not adaptive/propositional with respect to the partial results. In designing, instead, it is possible to put everything back into play, to make a leap that allows us to "change the point of view", to overturn the sense of every single previous choice, to accumulate meaning by stratifying new possible paradigms of reference.

We, therefore, set ourselves before the need to simulate all this, realizing that this would lead both to an increase in the identity of each individual/scenario generated, and to greater complexity of the final results.

The operational line chosen was to accept the presence of exceptions and to manage them as a trigger for possible overturning. The basic structure was already present. Every form that was generated and subsequently transformed was already, in itself, unpredictable. It was sufficient to set a threshold to this unpredictability by connoting as exceptional the forms that exceeded this limit (subjective). Every exceptional form, as such, instead of placing its demands in a contiguous field, and within the paradigm, placed them as a transformation of the paradigm itself. And paradigm transformation means the re-proposal of a subsequent paradigm that cannot be deduced from the previous one, even if it must understand it.

It is about making possible a discontinuity in the process, therefore a logical leap and simultaneously an increase in complexity. As when, in the evolutionary reality of a city, a cathedral is built. This event, which is considered exceptional, redraws and remeasures the relationships between what is present, stratifies a significant structure over the pre-existing one, multiplies the possible codes of reading and changes the very evolutionary logic of the system. In a simulation, a cathedral is not necessary, also because each real event has, on a different scale, its own component of exceptionality. In the experimentation, a subjective evaluation of the threshold of exceptionality was sufficient.

The event that is considered exceptional becomes the irreversible event that marks with a paradigm shift the time of the project, its evolution towards complexity. In morphogenetic terms, the exceptional event triggers a process called catastrophe and marks time by replacing one attractor with another more sympathetic one. [15]

## THE DESIGN OF MORPHOGENESIS

The series project varied through the genetic code of "species".

Particular attention must be paid when the morphogenesis project operates in industrial design. In the industrial object, the project of species expresses all its potential, since designing the imbalance, the evolutionary dynamics means finding in the generated objects the sense of the unrepeatable and surprising forms of nature. It is like operating with the objective of a generation of infinite unique objects, all different but all recognizable as species, as a multiple expression of the compositional idea that we are building.

And these objects, which the morphogenesis project generates in real-time as three-dimensional models, as virtual objects, have structural characteristics that make them naturally suitable to be produced industrially with numerically controlled machines.

In fact, the design of species and production using robots present exceptional synergies. The use of these machines has, theoretically, an equivalent economic cost whether the objects produced are all identical or different from each other. The cost of diversification is quantified in the work and in the reprogramming times necessary for the variations of the object in production. The project of species cancels this incidence, producing, in real-time, diversified virtual objects, which can already be structured and formalized as a reprogramming of a numerical control machine.

Working directly by designing the evolutionary dynamic is, therefore, an adaptation/overtaking of the specific field of design, which is in tune with a transformation, which has already partly taken place, of industrial production: the conversion from the assembly line to robots.

The result is the rediscovery of the unicum, as individuality within a species, which

re-proposes in the industrial object the aura [16] of a unique artistic object (or unrepeatable natural object) that had been denied by the technical reproduction of multiples. The generation of unicum also becomes normal in industrial production, as it has been for centuries in artistic production. What is still the norm today, the series of objects all identical becomes an exception due to the artificial freezing of an evolutionary moment.

This approach to design/production responds globally to needs that are typical of contemporary society [17]: a total quality that responds to needs not yet posed, that creates the multiplicity of possible references even before they are subjectively expressed, but within development dynamics in which heterotopia becomes a key to reading and quality control.

The current philosophy of industrial production, in the face of this emergence of requests, prefers and proposes "personalization", limited and signed series, the options that diversify. It, therefore, responds with more or less structured ploys.

The design of morphogenesis, on the contrary, faces in a direct and pertinent way the more and more pressing request of varied series, changing the design gesture from iterative to complex. The proliferation of different shapes, the operation and the qualitative control of an almost infinite universe of unique objects, but recognizable as a whole, becomes the natural unfolding of this design.

Each project is an original software, and when activated it produces an ever-changing series of virtual objects already structured as reprogramming for robots, or as a computerized three-dimensional model.

Even the design work changes, but only objectives (the species) and tools (the algorithms), not philosophy as a heuristic process of progressive discovery.

The various species hypotheses, once drawn with algorithms, can be evaluated only by reflecting on a considerable number of possible formal outcomes, which in their multiplicity make explicit the possible quality, and not through a single generated object. Every correction, innovation, adaptation is implemented directly on the generation codes, on the DNA that is being built as compositional logic. And this modifies the characters and the recognizability of the artificial species.

The hypothesis is especially, in order to be evaluated, made to run in the computer, and it is thus possible to reflect on the quality and relevance of the idea, analyzing the recurring character of the results of formalization in tens or hundreds of unique individuals produced for this verification.

With subsequent adjustments and corrections, as for the usual design, we get to define, each time, the structure of the single algorithm and the most appropriate dosage of the parameters in view of the compositional objective that is intended to be obtained as a recurring character upstream of the diversity of the individual objects generated. Each algorithm is, therefore, like a small formal gesture that reflects a facet of the compositional idea. It is an element that enters the heart/brain of this software/project forming a device that simulates the transformation of requests into forms. Each form, once generated, is reused as a request in the next cycle, and so on until it reaches the planned levels of design complexity.

Morphogenetic design is the design of the subjective modes of this approach, outlining this subsequent increase in complexity.

But that's not all. As in the reality of design, an initial contingent stimulus is needed to trigger the process, capable of creating the imbalance that is the terrain on which the design logic works. Every time we restart the process of the genetic production of the artificial, in order to generate a new unique object/individual, it is not possible to simply reset everything and start again. It is necessary to trigger the imbalance in the "primordial soup" by simulating a context (temporal, random, etc.) that, as in the real, is always

different. Practically all that is needed is the "memory" of the last objects made and an input that amplifies the importance, and therefore the exceptionality of some assets, to be able to simulate a beginning, which is, then, always a catastrophic event, a logical leap, a mode of activation always different, but "evolutionary", of the compositional logic, contained in the project of species. The beginning of becoming is, in fact, the coming out of nothing, by chance because one cannot come out of nothing in other ways.

The diversity and uniqueness of the object that will be generated come from this crumb of randomness/contingency [18]. The compositional evolution that will be simulated with the subsequent iteration of the "design gestures" manages to amplify, as in reality, the smallest of the initial differences, guaranteeing the unrepeatability of every single object produced.

The design of morphogenesis, defining the modes of development but not the occasion of the birth of individual events, operates as the genetic plant of natural individuals; it acts on the quality and recognizability that is upstream of the single result. The random/contingent difficulties that the activated process of development will encounter in its explicit expression will not hinder, but rather amplify the individuality, the aura of uniqueness that pervades every single, unrepeatable object that is generated.

The results.

1. The immediate result is that of having verified the possibility of operating experimentally on various and diversified hypotheses of compositional logic, and therefore of having identified the possibility of an instrument of representation and control of the design idea upstream of its extrinsic development. This feasibility widens the fields of relevance of the disciplines of representation, expanding the field of what is representable.

2. A representation tool structured in this way makes it possible to analytically assess the impact of the various phases of the design process in the construction of the final image. It allows the development of the compositional idea by experimentally acting on the individual parameters and algorithms that represent it. È

, therefore, a tool for an in-progress approach to the formulation of a compositional logic.

3. Within the disciplines of composition makes it possible to design the species rather than the individual. And this with the same progressions of approaching complexity that is proper to design.

4. On the level of urban image formation, it defines an instrument for verifying the relationship between architecture and city, since by repeating the simulation it is possible to construct three-dimensional models of random urban layouts that define the possible scenarios towards which design choices tend to be oriented. It, therefore, presents itself as an advanced tool for environmental impact assessment.

5. A contribution, especially relevant to the design sector, is that of being able to access the design of a "species" of objects, which can be produced with always different individual characteristics in a robotic factory, instead of single objects that can be produced in series of identical individuals, on an assembly line. At this point, the simulation of a design logic becomes itself a project of species (it was said meta-project) but immediately usable, as an "executive" project of objects always different but all characterized not only by the use but substantially by belonging to a logical matrix, different but recognizable by the same DNA.

*Note 1. In fact, these belongings allude to a post-metaphysical identity (Habermas, op.cit.), therefore strongly subjective and interpretative, but in fact, meta-projectural, which can be controlled and refined experimentally. This experimental factor has*

*allowed research in progress, on the complexity of the simulated world through a subsequent accumulation of possible subjective readings that, finding verification in multiplicity', allow to find some matrices credibly recountable in intersubjective contexts.*

*Nota 2. Herbert A. Simon, "Le scienze dell'artificiale", Isedi 1973 (The sciences of the artificial, Cambridge, MIT Press, 1969)*

*Translated from Italian version: " The complexity or simplicity of a structure strongly depends on how we describe it. Most of the complex structures in the world are enormously redundant and we can use this redundancy to simplify their description. But to use it, to simplify, we need to find the right representation. The idea of replacing a process description with a description of the state of nature has played a fundamental part in the development of modern science. Dynamic laws expressed in the form of systems of differential equations or finite difference equations have in many cases offered the means to describe the complex in a simple way. I have tried... ...to show that this characteristic of scientific research is neither accidental nor superficial. The correlation between the description of the state and description of processes is fundamental for the functioning of any adaptable organism, for its ability to operate teleologically on its environment. The current level of knowledge of genetic mechanisms leads us to believe that, even to describe itself, the multi-cellular organism adopts a process description (a genetically encoded program) as the cheapest and most useful representation".*

*Note 3. it is worth remembering what Bertrand Russel said, "Mathematics is a science in which you do not know what you are talking about, and you do not know if what you say is true".*

*Note 4. The usable system must be of the non-linear type, in order to have the possibility to simulate the proliferation of possible and unpredictable scenarios that each project can produce.*

*We remind here the Prigogine's indication of the difference between linearity and non-linearity:*

*"In a linear system, the effect of the combined action of two different causes is only the overlapping of the effects of each cause taken separately. But in a non-linear system, a small cause can induce dramatic effects not proportionate to its amplitude".*

*Gregoire Nicolis Ilya Prigogine, "The complexity", Einaudi 1991 (1987). op.cit.*

*Note 5. "If my alterations are further altered by the mind of the reader, then all the better. I will have favored creativity a little more; for creativity never derives from the perfect rendering of simple truth, but always from the inevitable errors of every translation. In those moments interpretation yields to interpenetration, and subjective ambiguity is allowed to dominate objective certainty. Gunnar Olsson, "Lines without shadows", Theoria 1991.*

*Nota 6. Renè Thom, "Stabilità strutturale e morfogenesi", □Einaudi 1980*

*"The notion of a space-time object alone implies the notion of a model. From this point of view, it will be said that an evolving system of forms constitutes a process that can be formalized if there is a formal system P (in the sense of formal logic) that*

*is satisfactory under the following conditions: Each state A of the phenomenological process under consideration can be parameterized by a system of proportions an of the formal system P; if in the course of time, state A is transformed into state B, B can be parameterized with a set b of the system P so that b is formally deduced from a within P; in other words, there is a bijective application of all or part of the propositions of P to the set of forms presented globally by the process, the inverse of which transforms temporal succession into logical implication. Such a formal model is not necessarily deterministic; indeed, from a set of premises of P one can generally deduce a great number of formally distinct consequences".*

*Nota 7. Gianni Vattimo, "La società trasparente", Garzanti □1989*

*"Beauty is not the place of manifestation of a truth that finds in them a sensitive, provisional, anticipatory, educational expression, as the metaphysical aesthetics of tradition have often wanted. Beauty is ornament in the sense that its essential meaning, the interest to which it responds, is the expansion of the world of life in a process of references to other possible worlds of life, which are not only imaginary or marginal or complementary to the real world; but compose, constitute, in their mutual play and as their residue, the so-called real world".*

*Note 8. G. Vattimo, op.cit.*

*Note 9. The essential aspect of the beginning of the becoming/project is highlighted by the same matrices of western civilization, which Severino synthesizes in this way: "For Greek thought the becoming of things is their coming out of nothing and returning to nothing - that is, their beginning to be and ceasing to be." Emanuele Severino, "Legge e caso" (Law and chance), Adelphi 1979.*

*Note 10. "What comes out of nothing begins in an absolute way, has no tendencies, vocations, inclinations, propensities, has no purpose, is not subject to rules, laws, principles. Behind it has nothing; its coming into existence is entrusted to nothing, it has no purpose, it has no purpose, it has no reason. Nothing is nothing and there can be no reason that pushes nothing in one direction rather than another. Precisely because it has been nothing, everything that in becoming begins to be is pure chance.*

*In the history of Western culture, the sense of chance is inextricably linked to the sense of nothingness. In its essential meaning, chance is the coming out of nothing, it is the falling into existence having been thrown from nothing. Becoming as such is chance. The so-called regularity according to which one arranges things that begin to be are only a fact, that is to say, they are themselves random". E. Severino, op.cit.*

*Nota 11. Renè Thom, "Stabilità strutturale e morfogenesi", □Einaudi 1980*

*"One of the essential factors of evolution is probably the attraction of forms; every form of its own (one would say an archetype if the word did not have a finalistic connotation) aspires to existence and attracts the wavefront of existence as soon as it has reached its own forms topologically close to it; there is competition between these attractors and one could speak of the malignancy of a form to indicate its power of attraction on the existing close forms... Among all living forms theoretically possible, only a very small minority will be touched by the wavefront and will come to existence".*

*Nota 12. Renè Thom, "Stabilità strutturale e morfogenesi" Einaudi 1980*  
"If you put in free interaction two dynamic systems A and B that present recurrence the AxB product system is structurally unstable; in general, if C and C' are the attractors presented by A and B at the time of coupling, the attractor product CxC' will suffer a catabolic catastrophe and will degenerate into an attractor K of small size contained in the product CxC'; this is the more general form of the phenomenon known in dynamics as resonance... I think that just to such a process we must attribute the control exercised by chromosomal DNA in the development.

*Nota 13. Ludwig Wittgenstein, "Tractatus logico-philosophicus", op.cit.*

*Nota 14. Gregoire Nicolis Ilya Prigogine, "La complessità", □Einaudi 1991 (1987)*  
An explicit example, in nature, of how a dynamic evolutionary process towards complexity can be triggered, is the life cycle of the amoeba *Dictyostelium Discoideum*, as Prigogine describes it: "amoebas in the unicellular stage" move in the surrounding medium, feed on bacteria and proliferate by cell division. Taken as a whole, they form a uniform system, since their density is essentially constant. Let us now suppose that amoebas are subject to starvation. ... We observe that individual cells do not die. Rather, they respond to the constraint [lack of nourishment] by aggregating to a center of attraction. The initial homogeneity is broken, the space becomes structured. The resulting multi-cellular body is able to move, presumably to seek more favorable conditions of temperature and humidity". And examining in more detail the process: "... after malnutrition, some cells begin to synthesize and release signals of a chemical substance (cAMP) in the extracellular medium.... ...which reaches the surface of nearby cells. These cells make an oriented movement called chemotaxis towards the regions with the highest concentration of cAMP, i.e. towards the pioneer cell... the aggregation process is accelerated by the ability of the sensitized cells to amplify the signal and transmit it back into the medium. This allows the organism to control a vast territory and form multicellular bodies... This constitutes what is usually called a "feedback loop", very similar to chemical autocatalysis or the self-acceleration of an exothermic reaction...".

*Nota 15. Renè Thom, "Stabilità strutturale e morfogenesi", □Einaudi 1980*  
"Any creation or destruction of shapes, any morphogenesis, can be described by the disappearance of the attractors representing the initial shapes and their replacement by capture by the attractors representing the final shapes. This process, called catastrophe, can be described in a space P of external variables.

*Note 16. Walter Benjamin, "L'opera d'arte nell'epoca della sua riproducibilità tecnica", (The work of art in the age of its technical reproducibility), Einaudi 1966.*

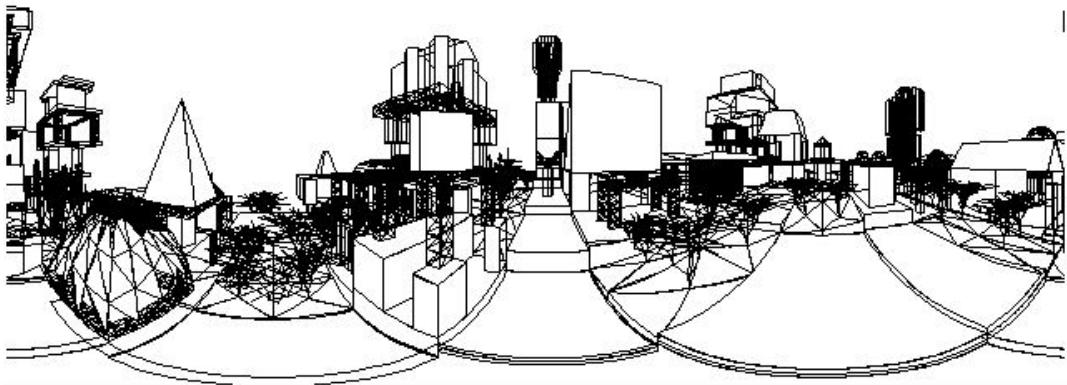
*Nota 17. Gilles Deleuze, "La piega", Einaudi Ed. 1990 (1988). "... la nostra situazione attuale, quando la fluttuazione della norma subentra al permanere di una legge, quando l'oggetto si inserisce in un continuum per variazione, quando la scienza della produzione o la macchina a controllo numerico si sostituiscono allo stampaggio. Il nuovo statuto dell'oggetto non lo ricollega ad un modello spaziale, cioè ad un rapporto forma materia, ma ad una modulazione temporale che implica una messa in variazione continua della materia come uno sviluppo continuo della forma".*

*Nota 18. Jorge Luis Borges, "Finzioni", Einaudi 1955*

*"Almost immediately understood: "The garden of forking paths" was the chaotic novel; the words [in the author's autograph] "to the different futures (not to all)" suggested to me the image of the forking in time, not in space. A new reading of the whole work confirmed this idea. In all narrative works, each time you are faced with different alternatives, you decide for one and eliminate the others; in the almost inextricable Ts'ui Pen, you decide - simultaneously - for all. Thus different futures are created, different times, which in turn proliferate and bifurcate... "The garden of forking paths is an incomplete, but not false, image of the universe as conceived by Ts'ui Pen. Unlike Newton and Schopenhauer, his ancestors did not believe in a uniform, absolute time. He believed in an infinite series of time, in a growing and dizzying web of divergent, convergent and parallel times. This weave of times which have been approaching, bifurcating, cutting or ignoring each other for centuries, includes "all" possibilities".*

## **ENVIRONMENTAL SPECIES PROJECTS: THE METROPOLIS**

### *THE CONTEMPORARY CITY THE METROPOLITAN SQUARE*



*La città è lontana. Me ne giunge, a volte, nella calma del vespro, il suono delle campane. Ma ora quelle campane le odo non più dentro di me, ma fuori, per sé sonare, che forse ne fremono di gioja nella loro cavità ronzante, in un bel cielo azzurro pieno di sole caldo tra lo stridio delle rondini o nel vento nuvoloso, pesanti e così alte sui campanili aerei. Pensare alla morte, pregare. C'è pure chi ha ancora questo bisogno, e se ne fanno voce le campane. Io non l'ho più questo bisogno; perché muojo ogni attimo, io, e rinasco nuovo e senza ricordi: vivo e intero, non più in me, ma in ogni cosa fuori.*

*The city is far away. Sometimes, in the calm of vespers, the sound of bells comes to me. But now those bells I hear them no longer inside me, but outside, for their own sake, ringing, that perhaps they are thrilled with joy in their buzzing cavity, in a beautiful blue sky full of warm sunshine among the squeal of swallows, or in the cloudy wind, heavy and so high on the air bells. Thinking about death, praying. There are also those who still have this need, and the bells make their voices heard. I no longer have this need; for I die every moment, I, and am reborn new and without memories: alive and whole, no longer in me, but in everything outside.*

*Luigi Pirandello, "Uno, nessuno e centomila"*

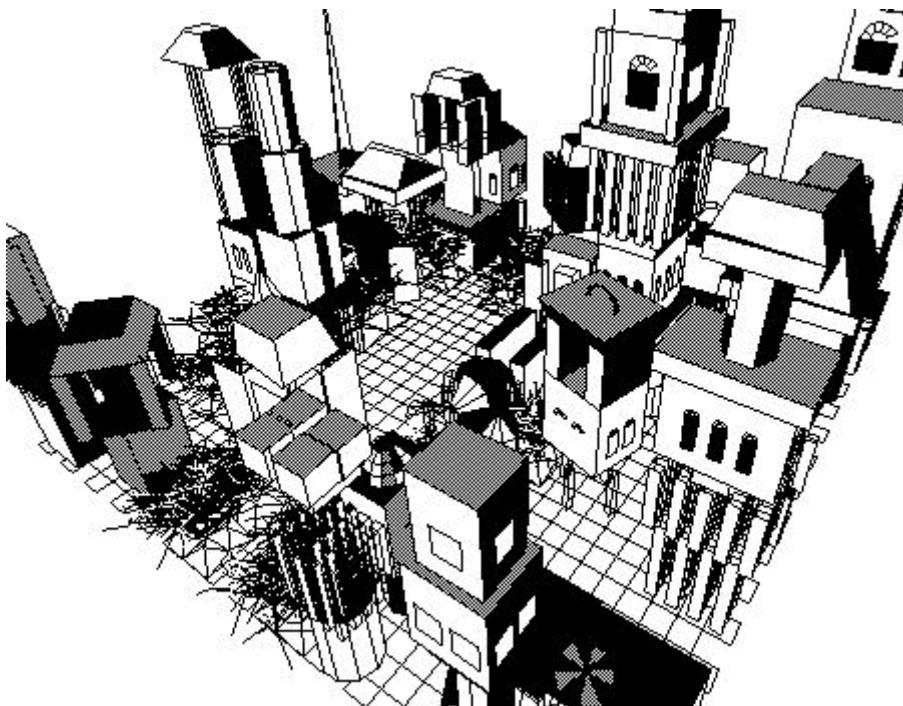
These projects are the results of experimental research on the contemporary city and its morphogenetic processes. Starting from a well-established fact: the failure of modern urban planning to design the city from scratch, i.e. to find a design order that succeeds in provoking the city effect, that mixture of complexity, quality, and informative charge, but above all the patina of experience, which makes an environment responsive to human needs [1].

The presupposition from which this research started is quite obvious but not completely experimented on the virtual: the city effect, the metropolitan image is built with time, and with the simultaneous contamination between subjective, random and necessary; meaning as necessary everything that goes beyond the subjective: both the

intersubjective demand, therefore based on the collective enlargement of the imaginary of reference, and the subjective one strengthened by power, and structured in program. The metropolitan complexity is reached with time, but also with the use of time as an opportunity for successive contaminations, for progressive and unpredictable reversals of any paradigm that might have been consolidated tending towards conservation, balance.

If this is an acceptable and sharable hypothesis, it is not so easy to experiment by model simulations, which can then be repeated to verify possible parallel deviations. The simulation, in fact, is not the lived experience, of which we could never know what would have happened if...

Working on the morphogenesis, on the dynamic structure of the evolution of the urban image, means to develop tools that operate directly on the imbalance, or rather that produce it experimentally as a peculiar character of the operational model, and repeat on demand such imbalance to experiment it with different paths and contingencies.



*Fig. under the title: Total perspective of a "Modern City". above: Metropolitan Square*

The species projects implemented followed this experimental approach, trying to produce/reproduce an environmental image, a metropolitan genetic code that traced the character of some urban species. And verify, in the simulated species, such as The Modern City (made in the image of the EUR of Rome, but subjectively amplifying some characters and potential) the relationship between urban image and dynamic evolutionary system. With this, identify the concomitance between partial choices and the metropolitan image. We certainly do not want to propose here a cause/effect relationship: the final image does not derive, as necessary, from the parameters adopted, but it is probable, it is plausible that an image of that type (with those certain characters and with that identity and recognizability) will be generated if certain parameters and the same procedures are

adopted.

Given that the field of experimentation, as it has been identified, arises from the simulation of contaminations between subjective, random and "necessary", the next species project, The metropolitan Square, was developed to verify, in more detail, the role of the exception in the development of a dynamic system.

In other words, this project uses the exception, and its acceptance by the evolving system, as an opportunity to develop one of the qualifying and characterizing elements of the metropolitan context: the square. By simulating what happens in real urban time, when it happens that an architectural event becomes, for unpredictable or programmed, subjective or random causes, an exception in the context, the evolutionary structure of the environment changes, and accepting the exception restructures its insertion. For example, by creating in the surrounding urban fabric a space capable not only of making the exception appreciable as such but of qualifying itself through this "different" presence. The exceptionality is then reabsorbed by the system as an amplification, unexpected but necessary (a posteriori), of its own character, of the same recognizability of the urban image that, in the virtual time of the simulation, is being realized.

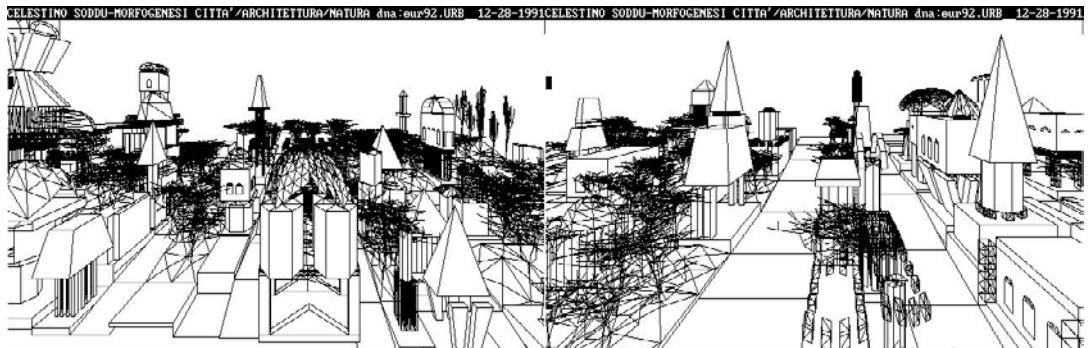
To simulate these possible stories, this virtual temporality, is, therefore, to access, directly, to the complexity. And through these experimentations to control its growth, to reread the how of the formal genesis of the metropolitan image.

But also identify a possible design approach to the urban image. The idea that generates a specific metropolitan character is not, and cannot be a unique and contingent gesture. Nor can it be a system of rules and constraints, or guidelines on which to proceed. It can only be the project of an evolutionary code, of an open and always evolving way of seeing the city, of comparing it with the collective imagination, also in an evolution.

An approach that allows not to lose, in this slow becoming marked by randomness and unpredictable subjective contributions, the urban identity, of that particular and unrepeatable city that, however, it transforms, can remain recognizable, can preserve, even increase and refine through the contingent, its capacity of response and fascination.

*Note 1. We have witnessed the failure of urban utopias. Think of the Siemens districts of Berlin or the English New Towns. Environments that today, even if they are not physically degraded, are deprived of that quality that is found only through adaptability to temporal variables. The only charm, if you can call it that, of these places is that of absence and emptiness. Since time designed is that of unrealized utopia, they were born and lived in this absence. Which makes them suspended in an existential dimension of deep anguish. If ideologies are extinct, these quarters, which were supposed to represent the rigor and dignity of the working classes, instead violently denounce the unavoidable overwhelming power of advanced society. Their total museification is expressed from the beginning. This is a sadness that we all have in our hearts.*

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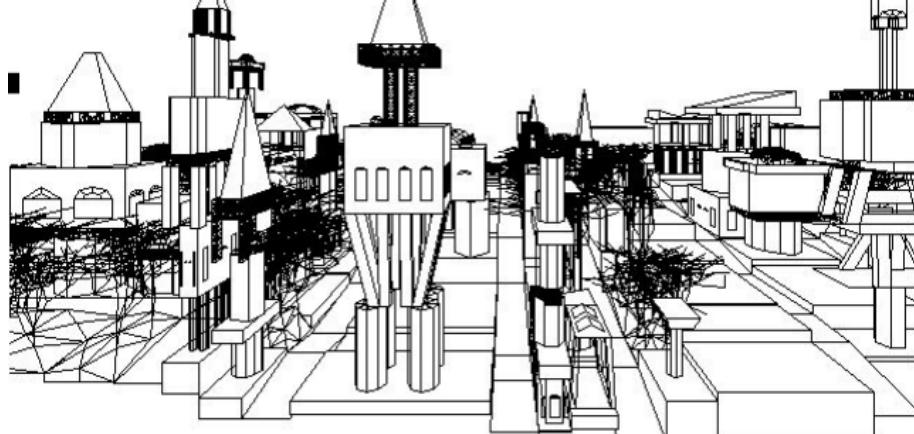


*In the images, metropolitan scenarios of "Modern City"; the urban species is born from the interpretation of EUR in Rome.*

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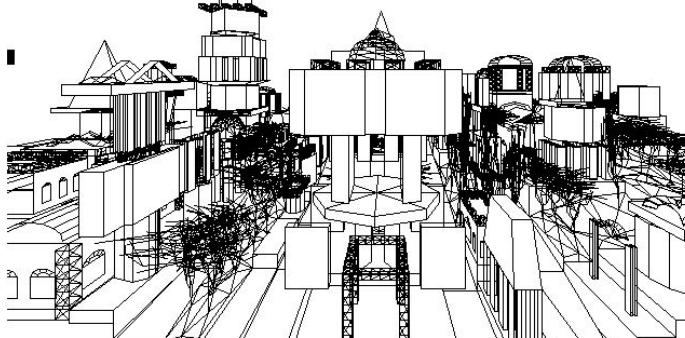


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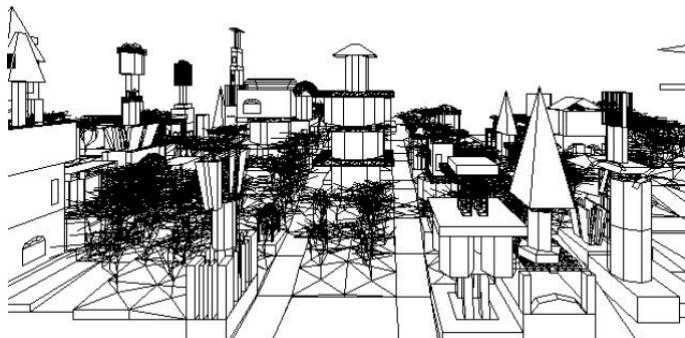


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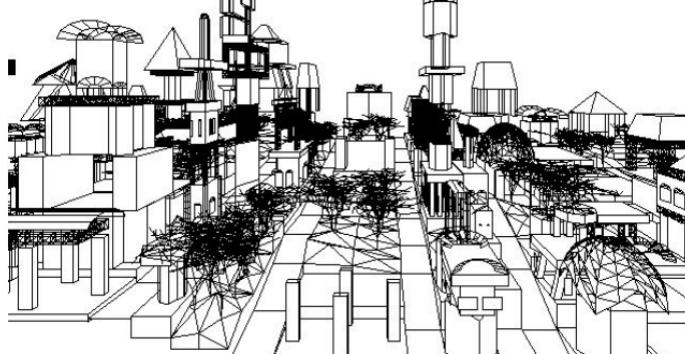
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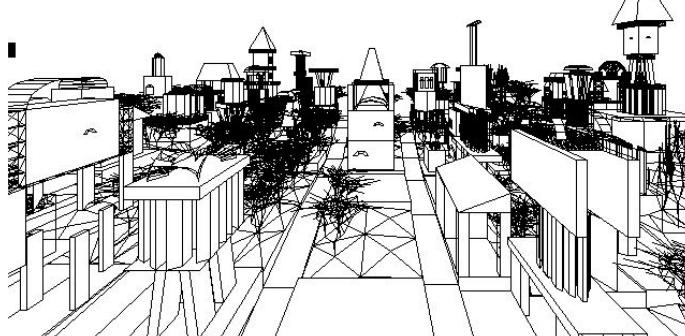
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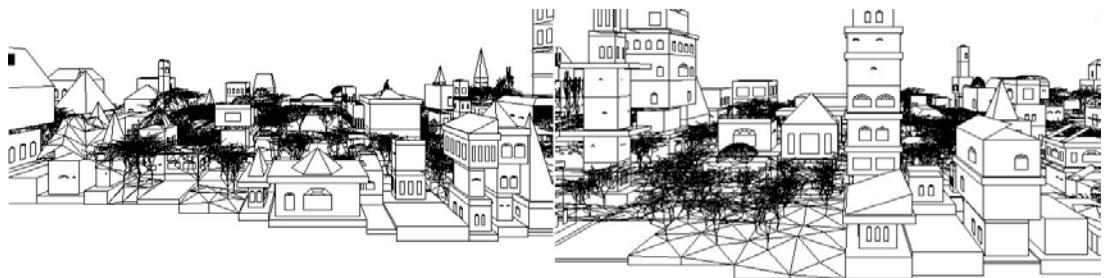
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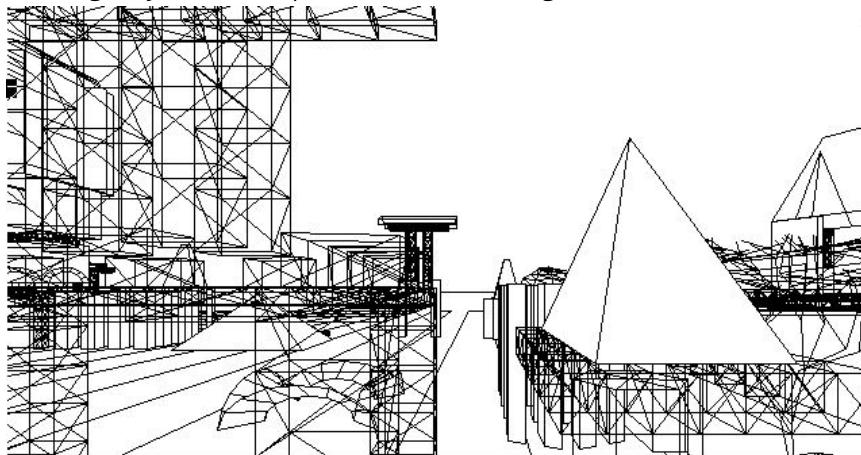


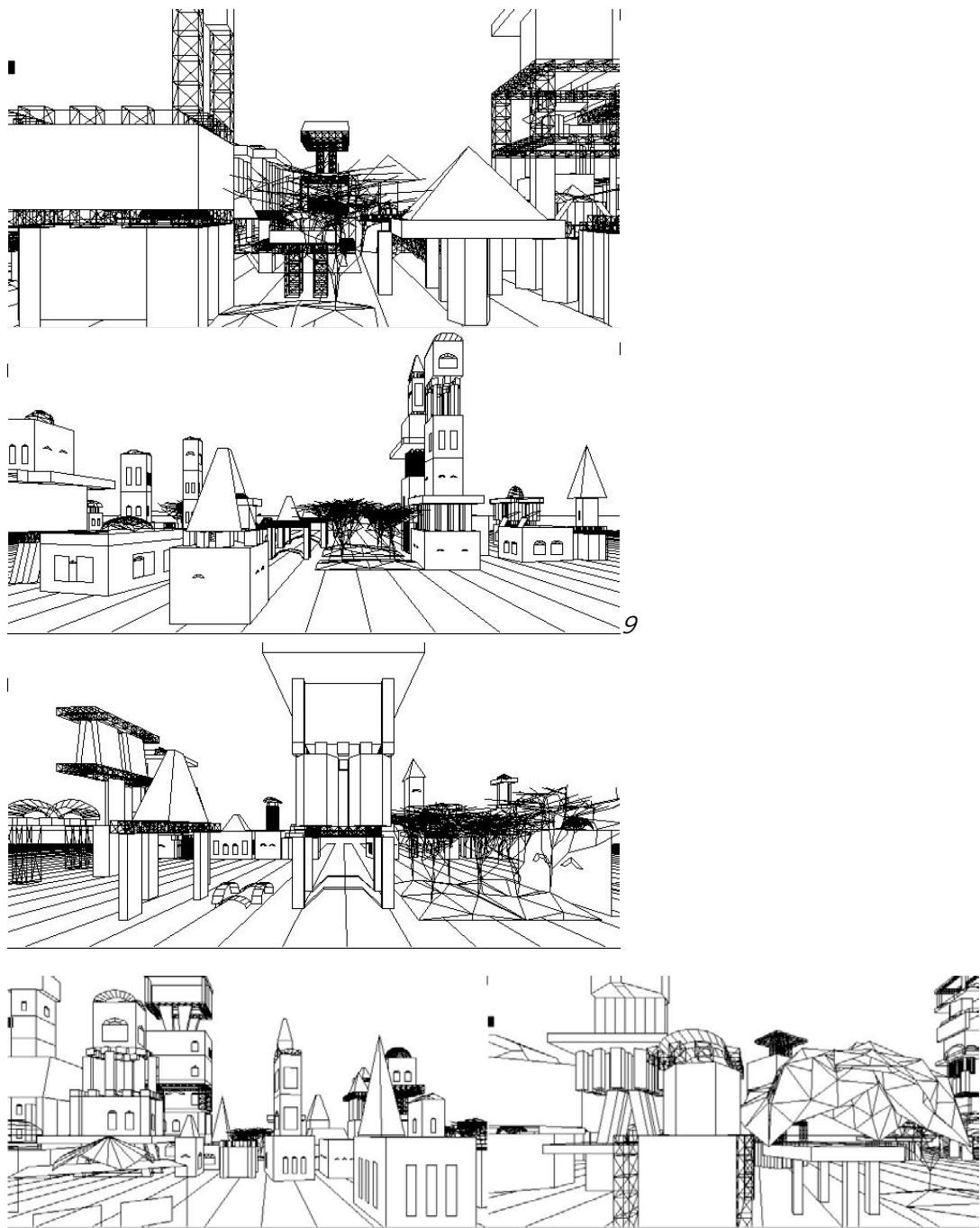
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Above two scenarios of the Suburbs species.

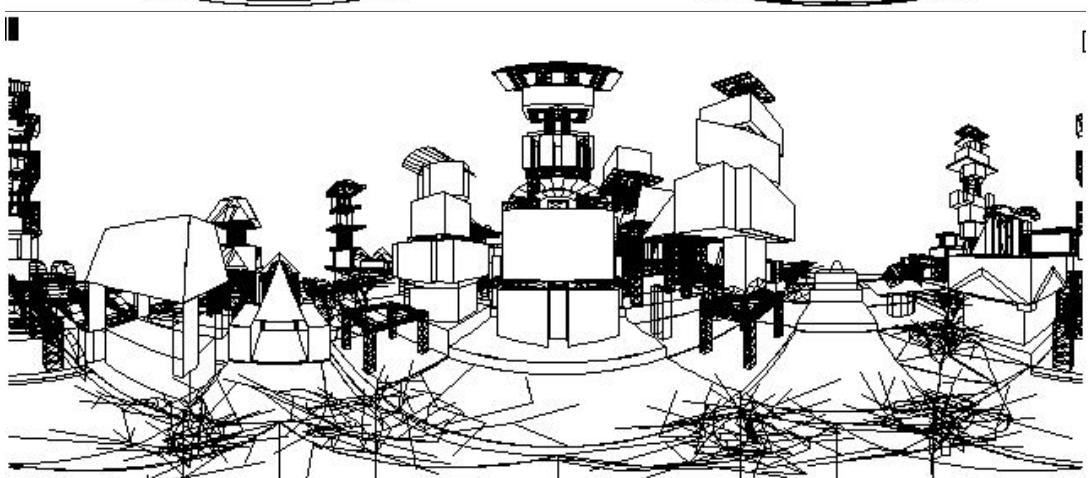
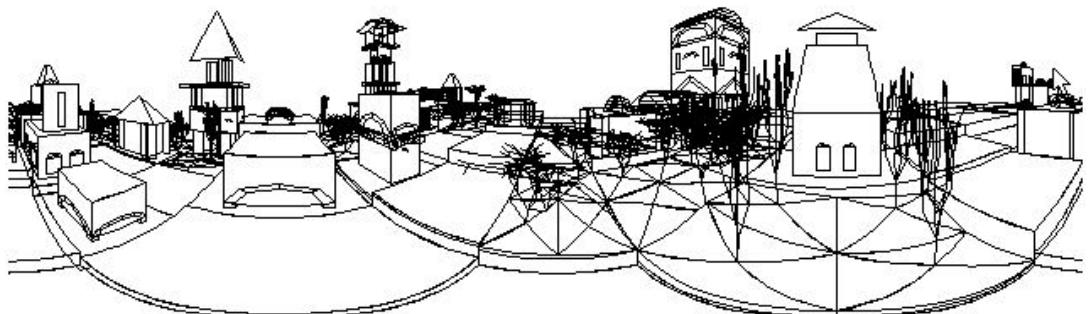
Below is a series of possible models of Piazza Metropolitana built on a subjective reading of the imaginary reference (postmodern) of the eighties.



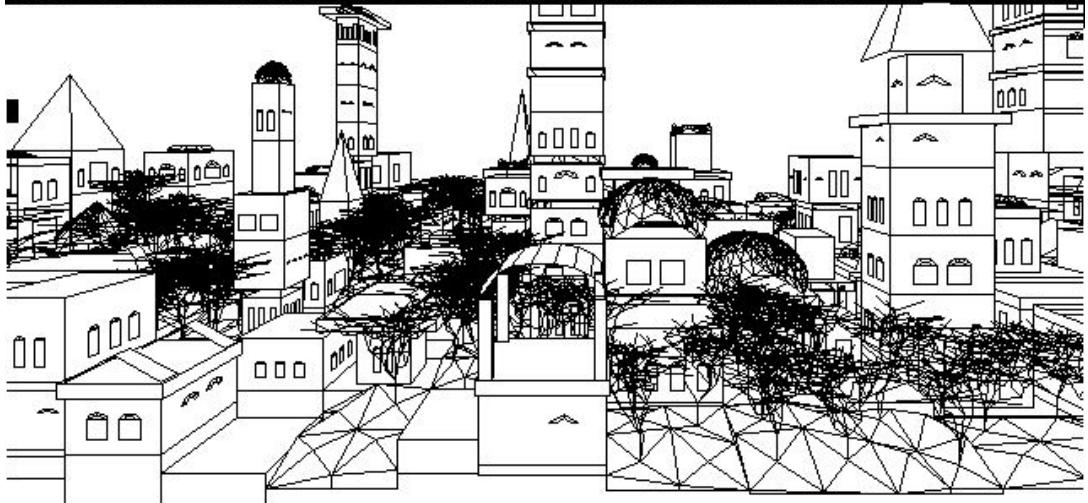


Above a scenario of the Periphery species, below and on the next page a series of models of the "Modern City" species.

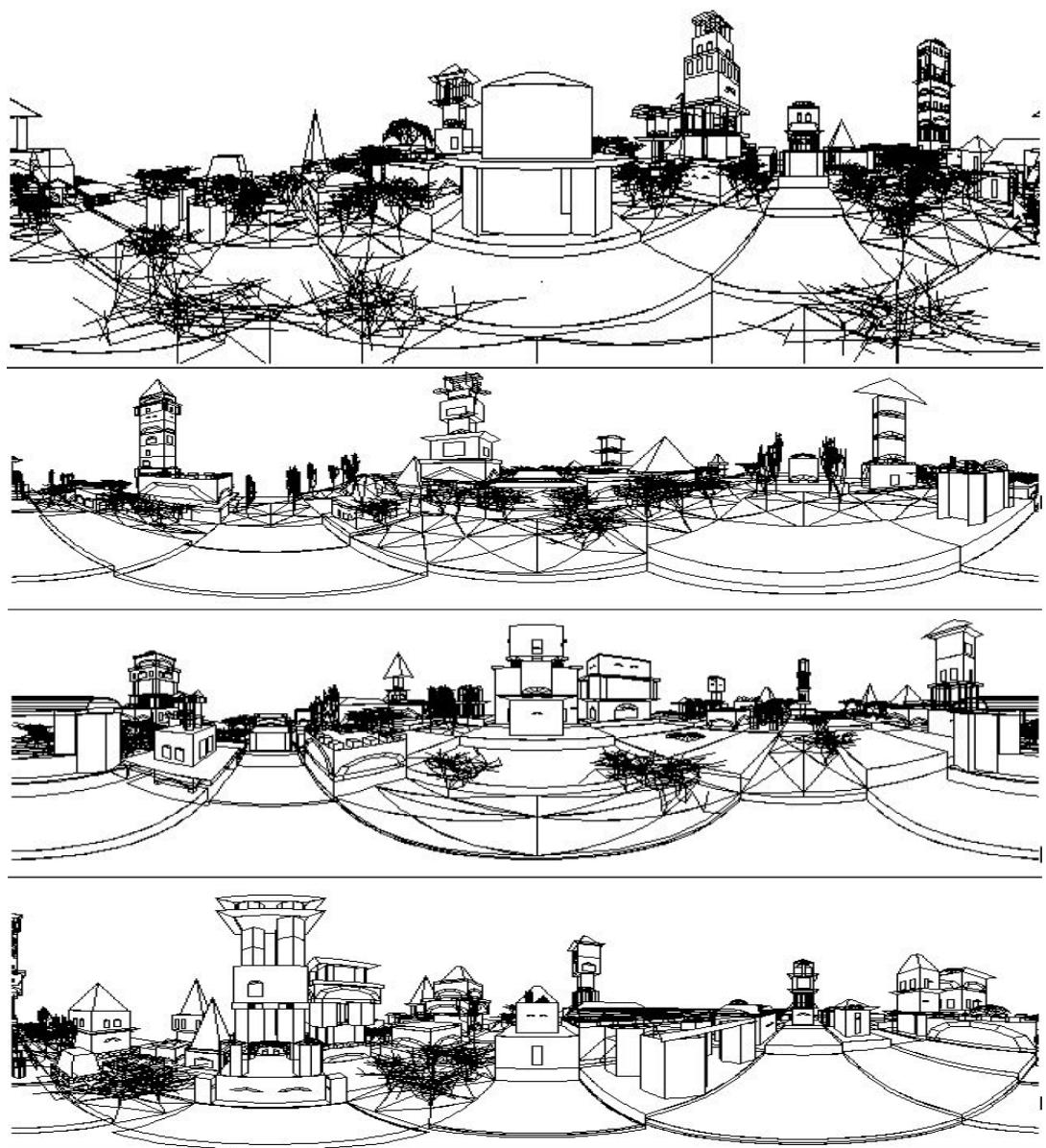
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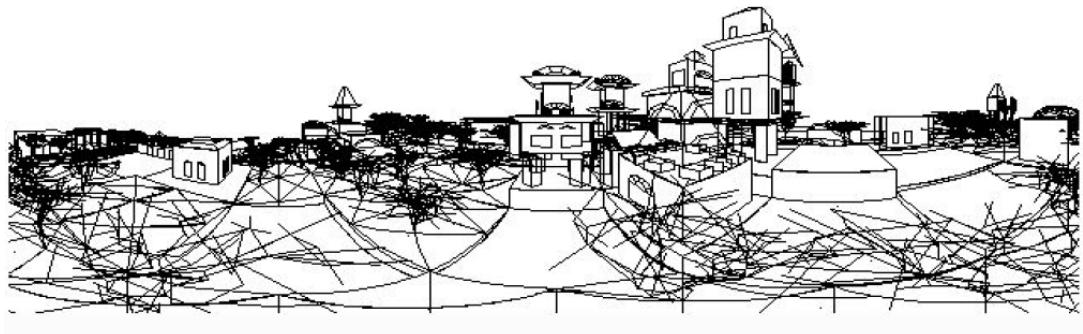


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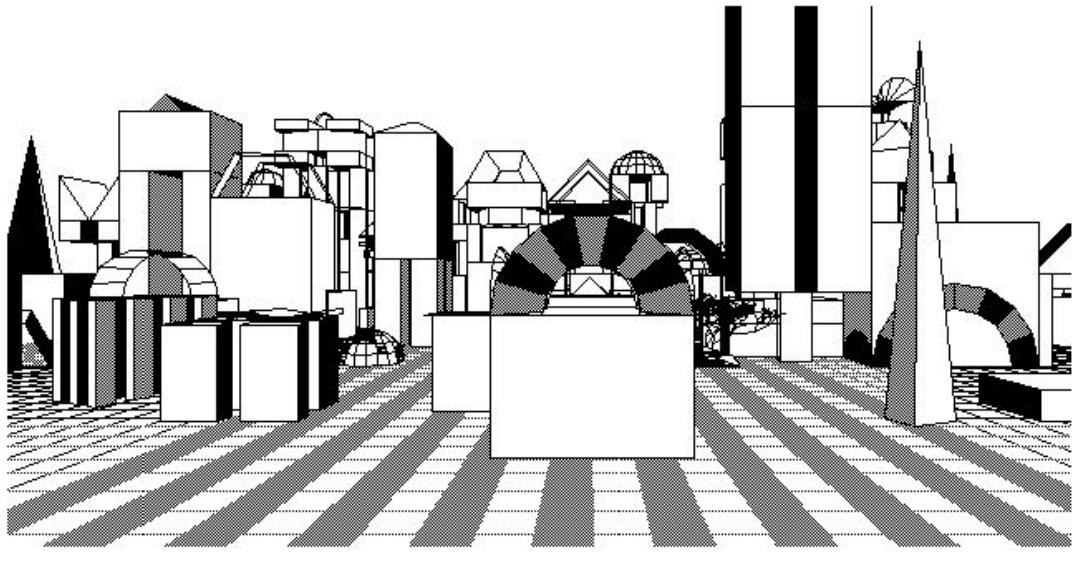
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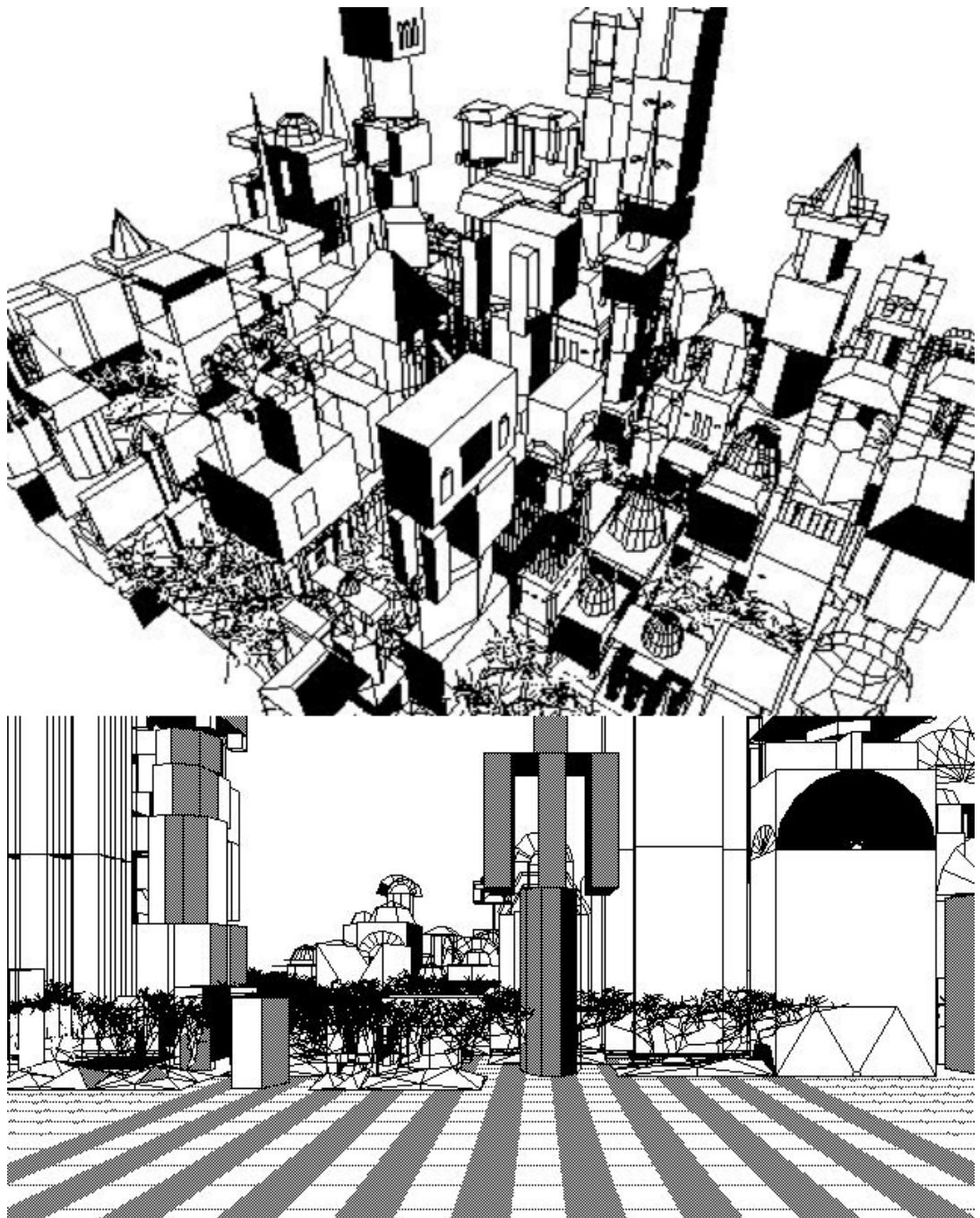




*In the upper images a series of different models generated by the Piazza Metropolitana species project; in the next page one of the models in zenithal view and, in the next page a series of possible urban scenarios realized with the same species project*

*The following images are related to scenarios generated by the project of the Modern City species, using subjective imagery that traces a rereading of Rome's EUR.*

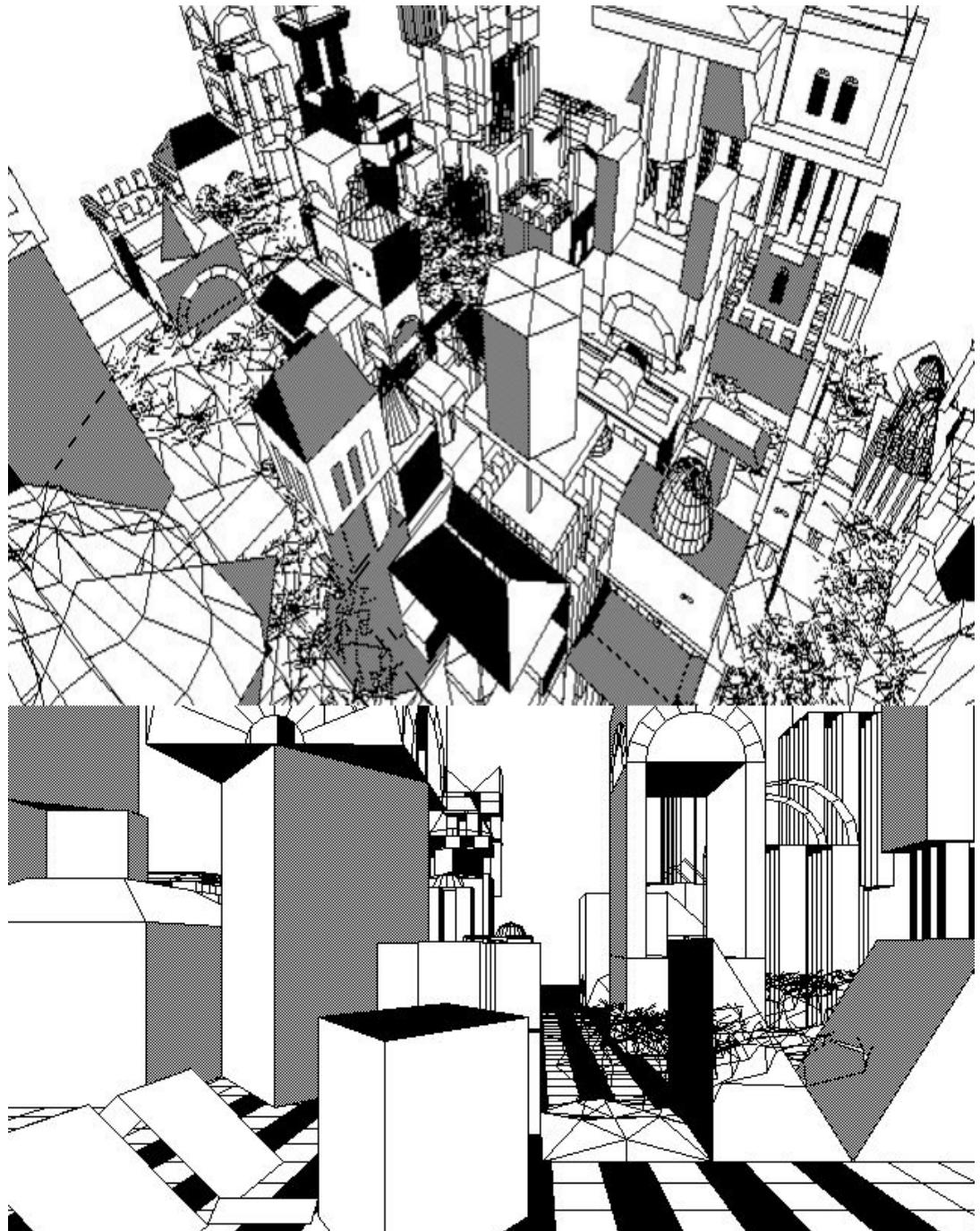




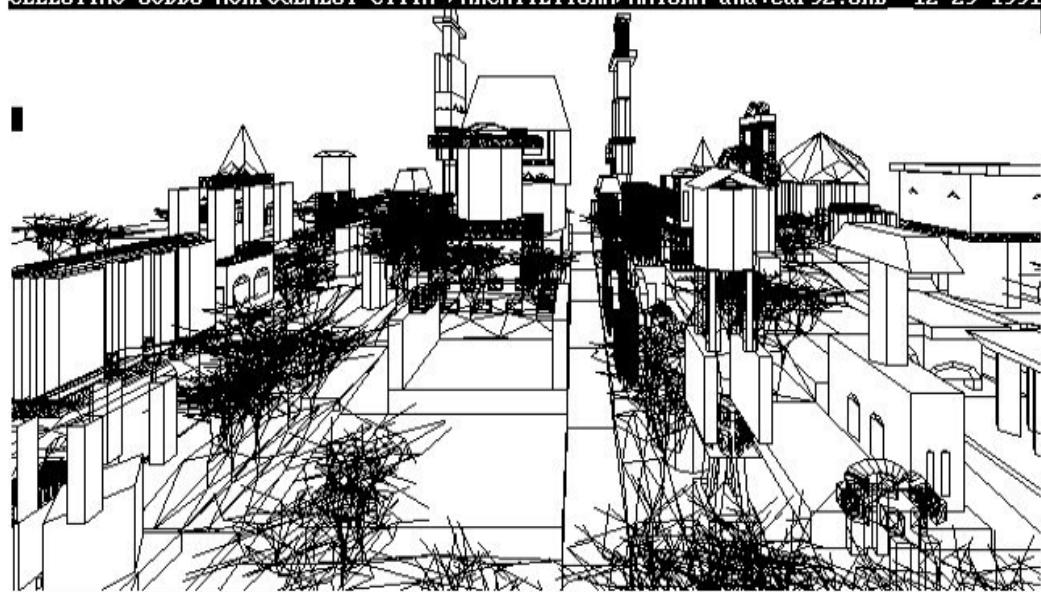
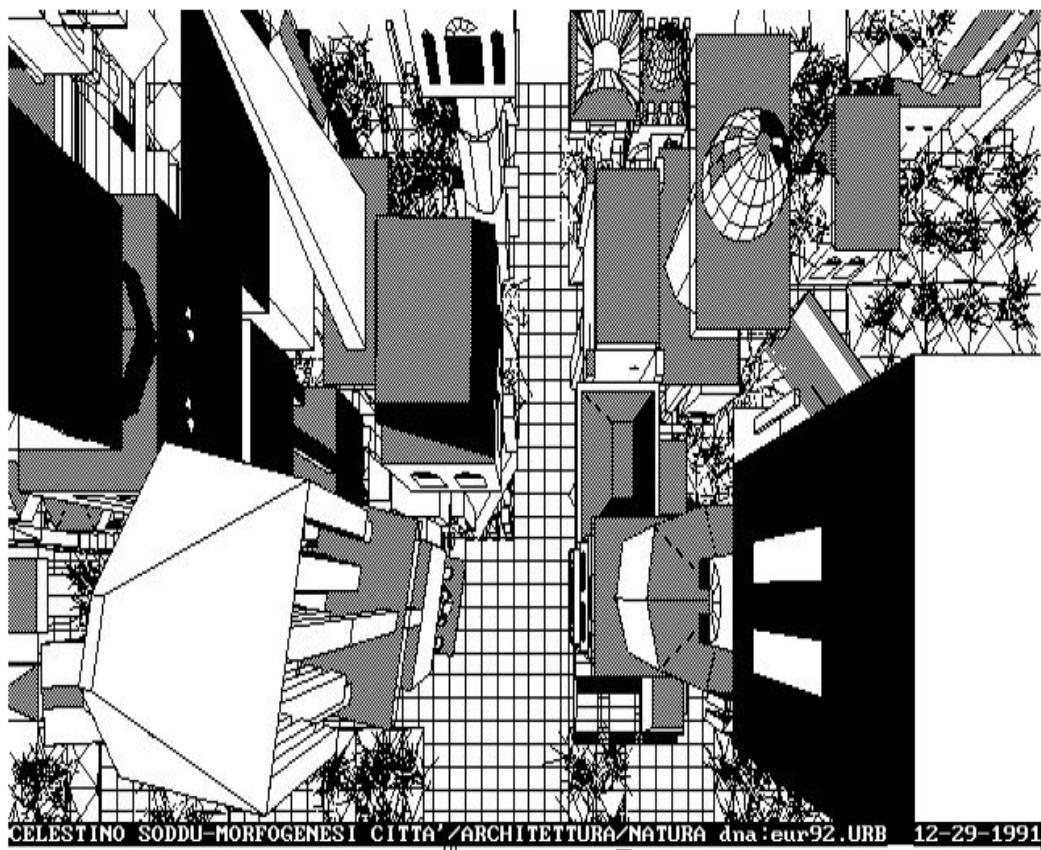
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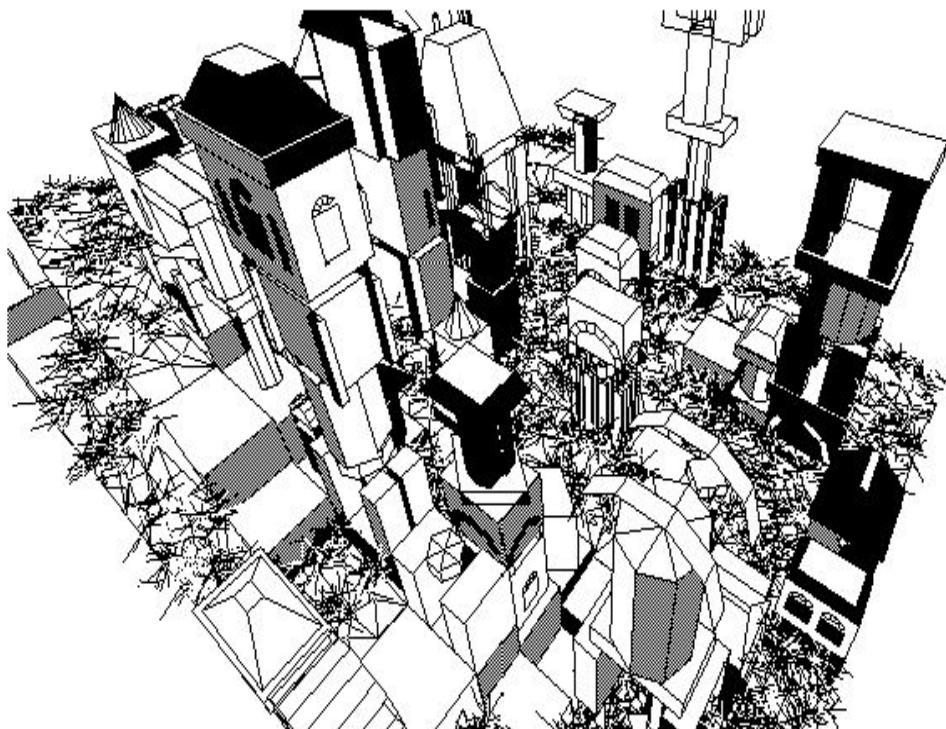
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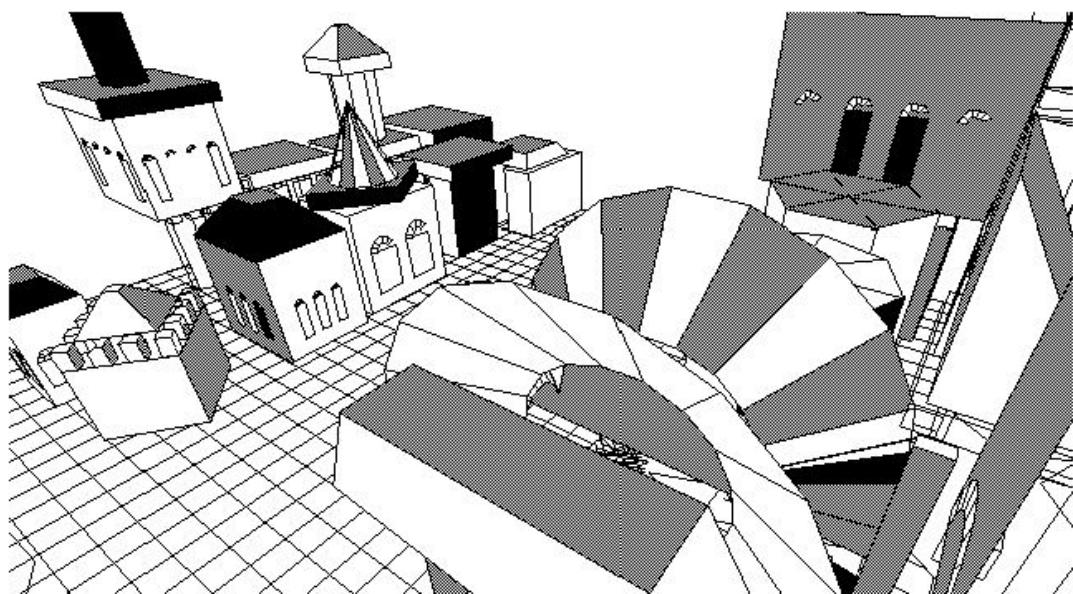
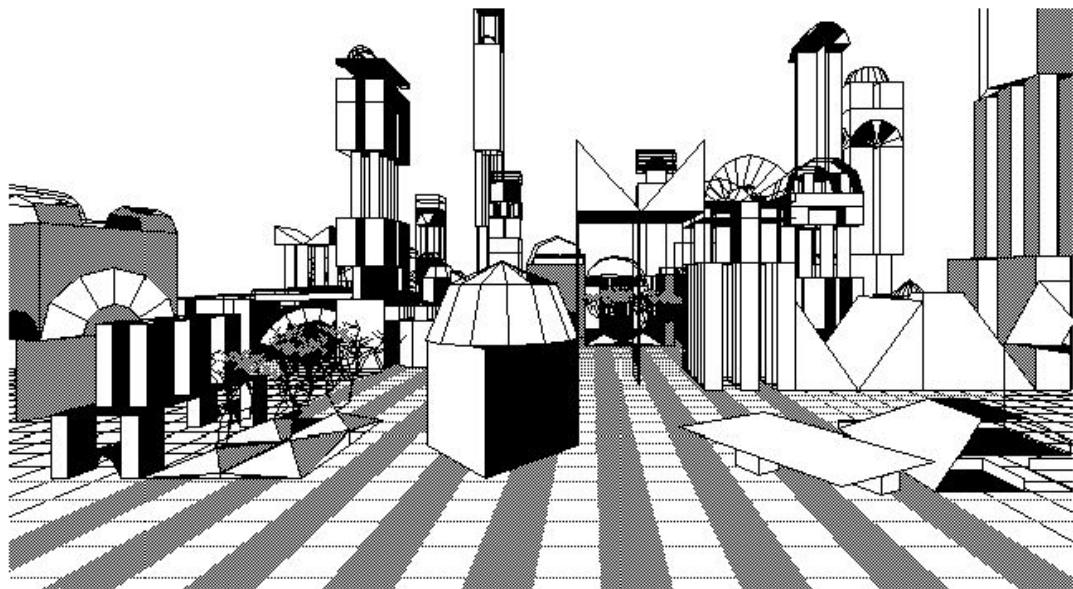


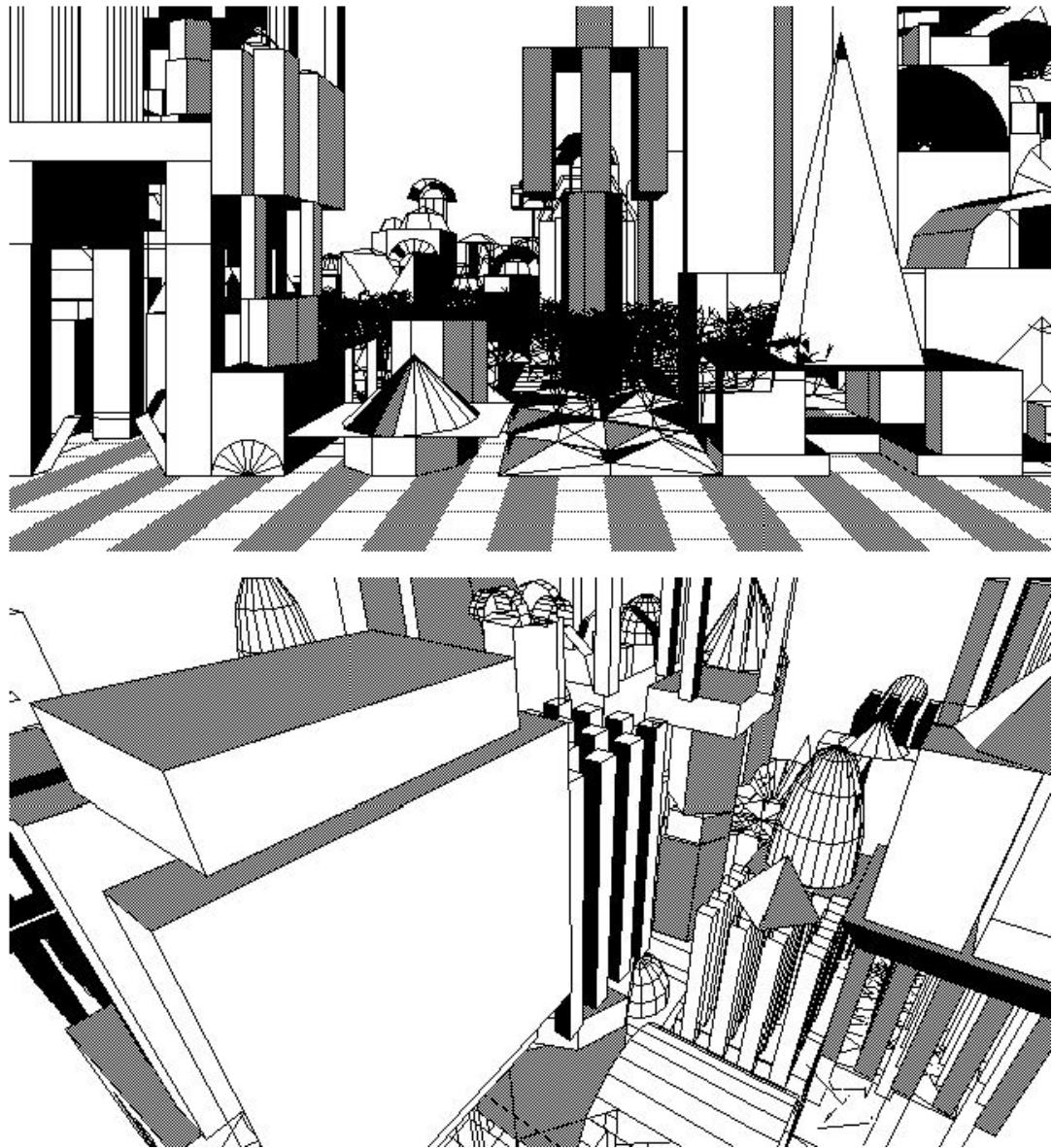
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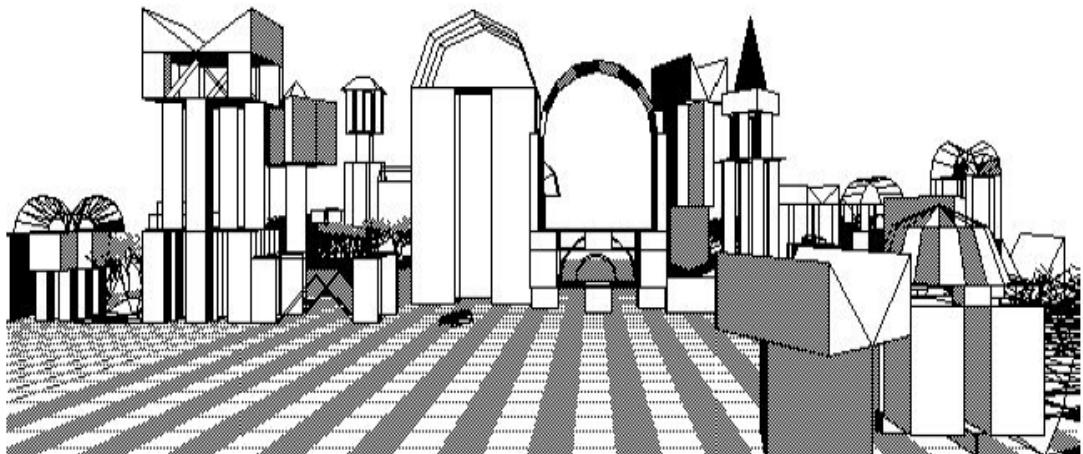
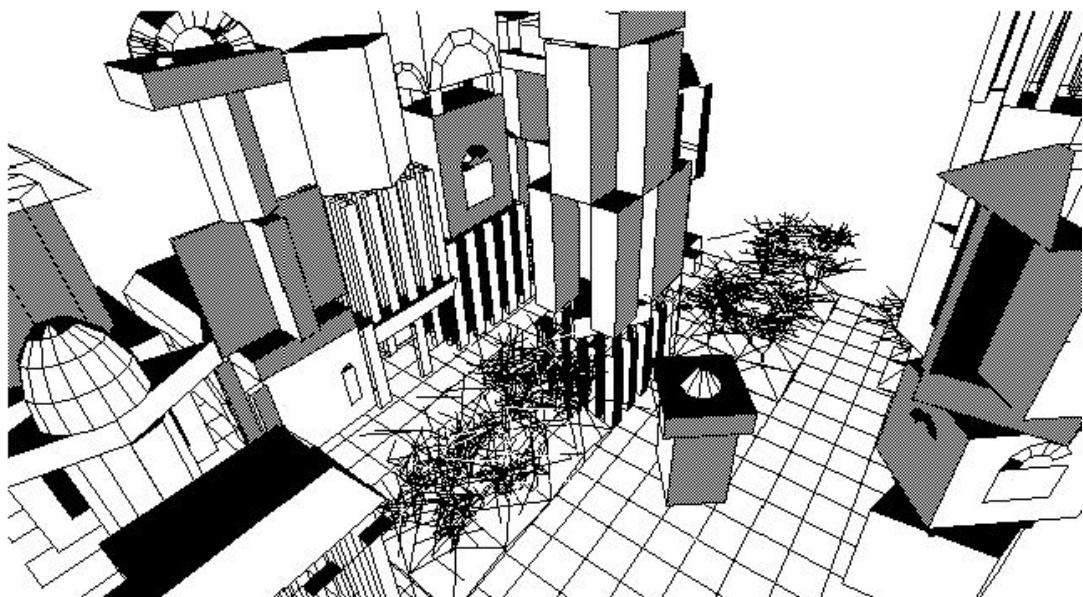


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## **ENVIRONMENTAL SPECIES PROJECTS: CITIES ON THE WATER**

OVERLOOKING THE SEA / ISOLABELLA / METROPOLITAN ATOLL



" He was surrounded by a veranda where the calm claws of the leaves gave shade, thickness, and disorder. You could not see the sea from up there, you could hear the sound of the water when it foamed and raged. So even leaves disturbed by storms bowed down almost as if they had ears. In autumn, they would crackle and crackle. It was the breeze playing with the dust."

Fleur Jaeggy, " The water statues "

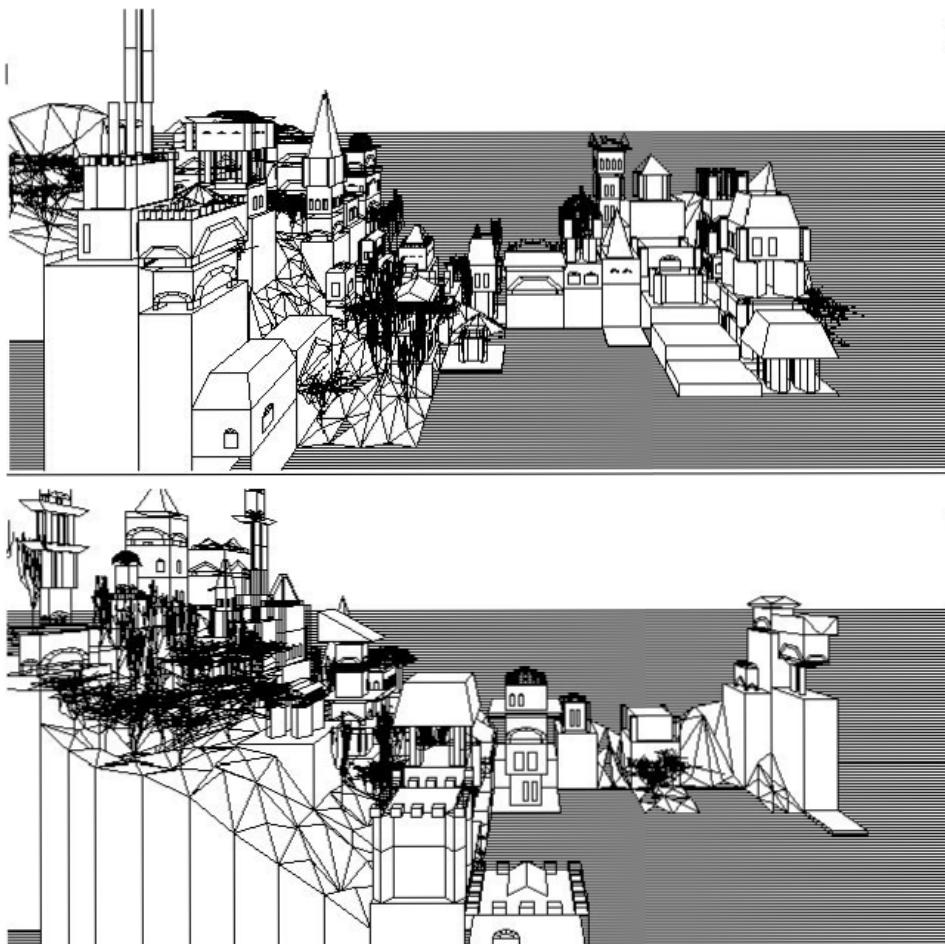
The objective of these species projects is the construction of possible morphogenetic codes of environments characterized by a direct relationship with the sea, and by a morphologically impervious hinterland. The reference is, of course, to an environmental context typical of the Ligurian coasts, from Camogli to Montecarlo, where the natural impervious and the artificial coexist and contaminate each other, continuing to affect, together, the evolution of the environmental image. But the references are also to the Adriatic cities, from Venice to Rovinj, or to the lakeside islands of Lake Maggiore where the natural imperviousness is not in height, between steep mountain and sea, but in the fluid, evanescent and always changing demarcation, between land and water, between nature and artifice.

The natural/artificial complexity of this environment, and in particular of the places where this environmental structure has become a city, arises from this recurrence of natural evolution and increase of the artificial, and from the randomness of the contingent events that have determined these dynamic contaminations. The necessary simultaneity of these two systems, the natural and the artificial, each with extremely different evolutionary times and cycles, contradictory and at the same time supportive as both dynamically oriented with progressive shifts towards increasing complexity, determine both the unpredictability of the total system and the very substance of its

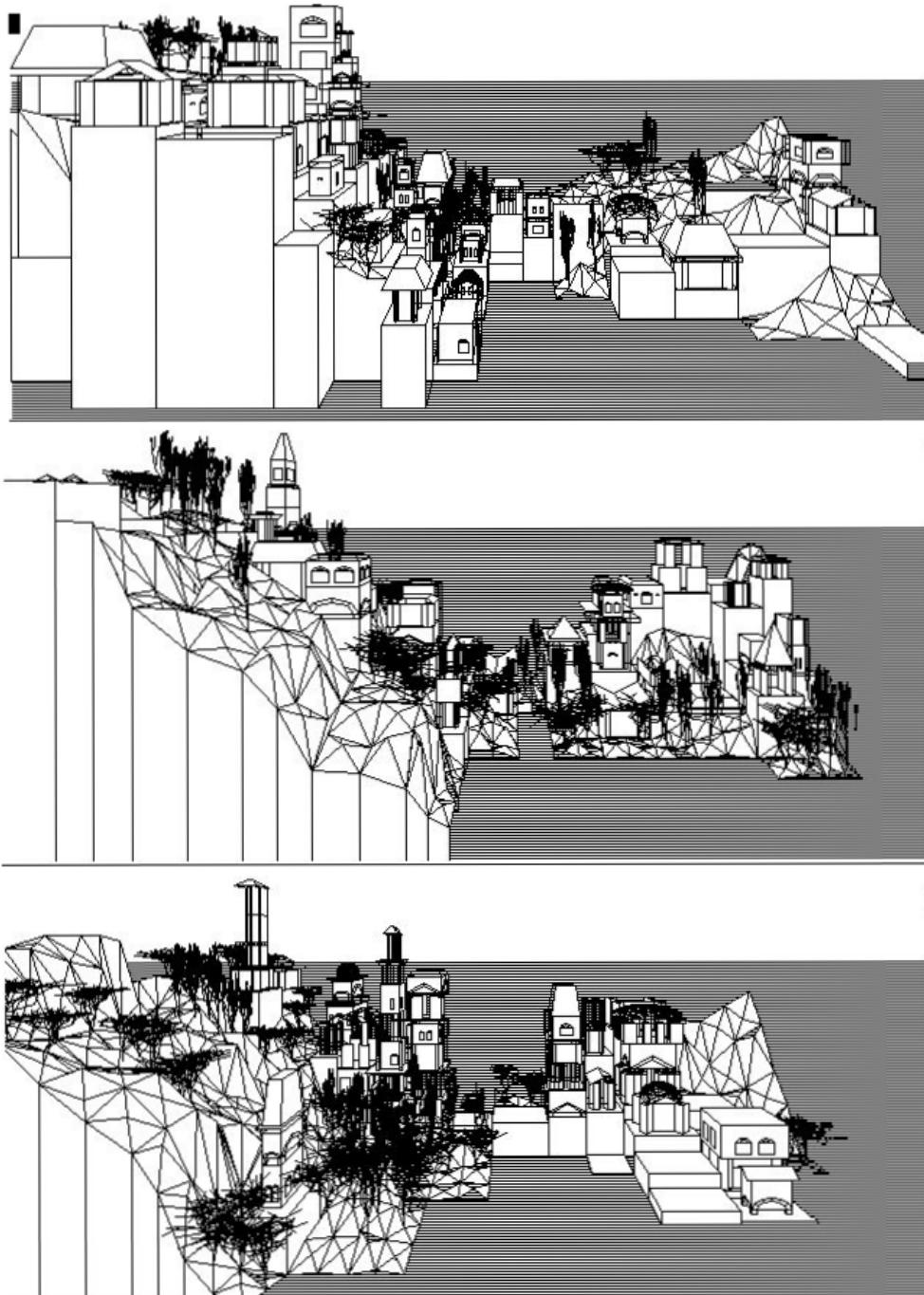
capacity for fascination.

The project of species A Picco Sul Mare operates with this imaginary reference. It tends, through successive adjustments and increases in complexity, to identify the compositional matrices of an environmental image so seductive and so responsive to specific human needs as is that of the cities overlooking the sea. The ability to fascinate arises from the fact that the needs to which it responds touch different fields across the board, from symbolic matrices to aesthetic satisfaction, from human pride in the ability to dominate nature in the search to ensure that its natural structure remains uncontaminated, from the impassable as a challenge to the concrete response to some practical needs related to everyday life.

*In the images in this chapter, in sequence, a series of different scenarios generated by the projects of species A Picco sul Mare, Isolabella and Atollo Metropolitano.*



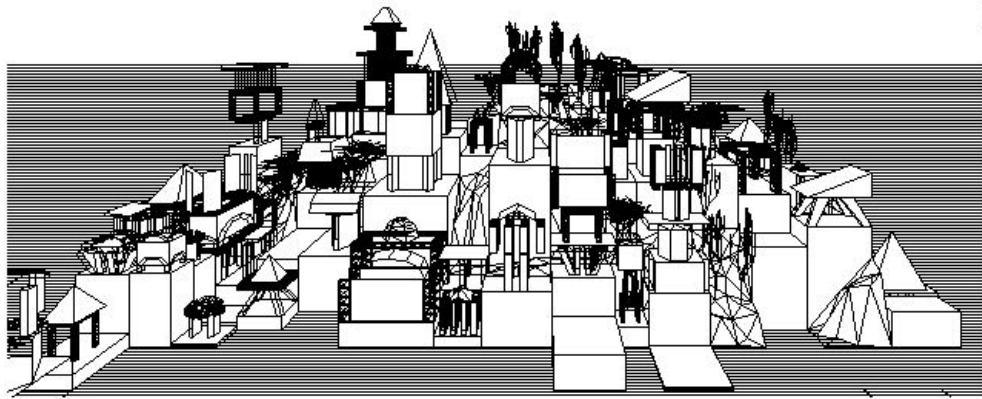
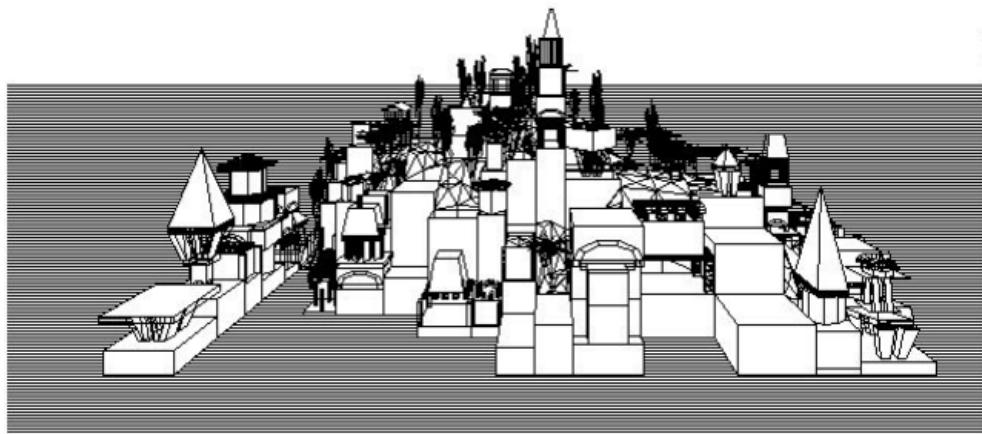
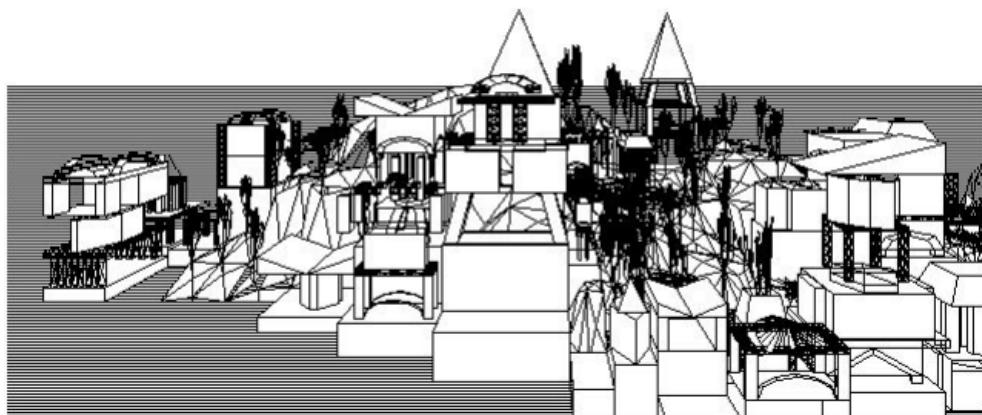




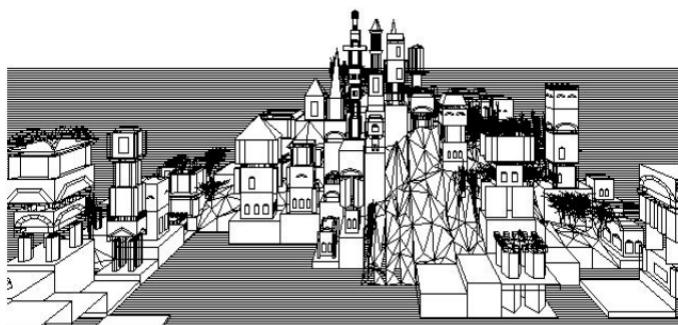
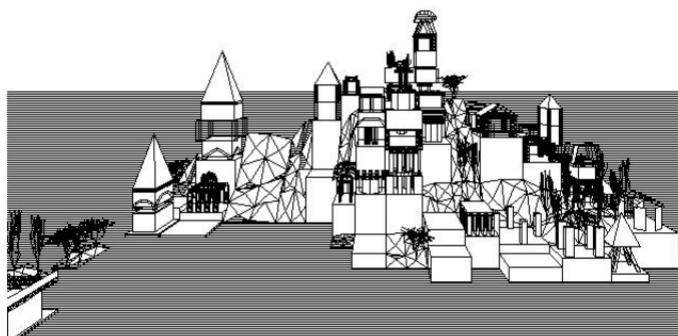
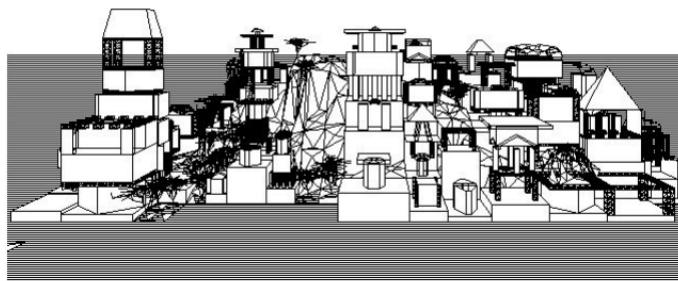
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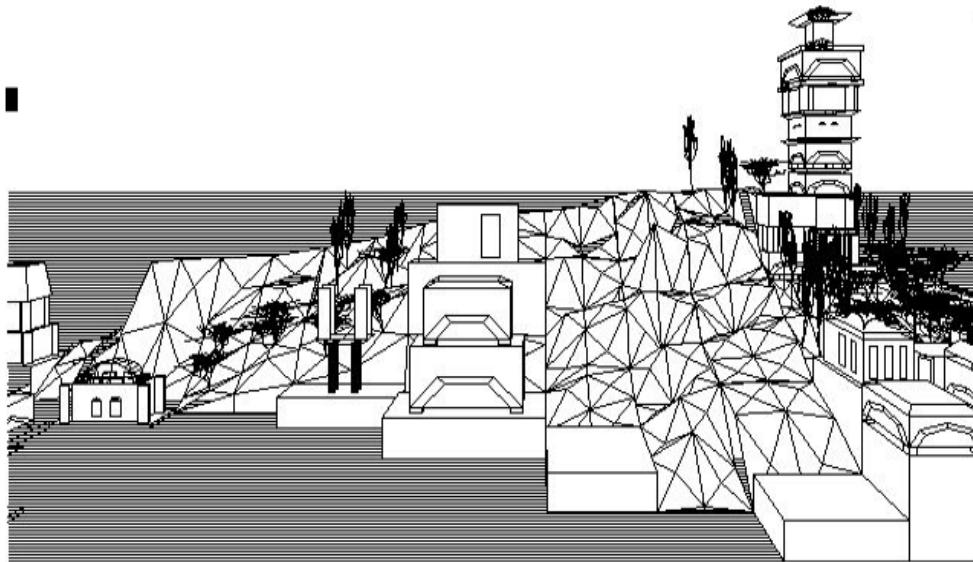


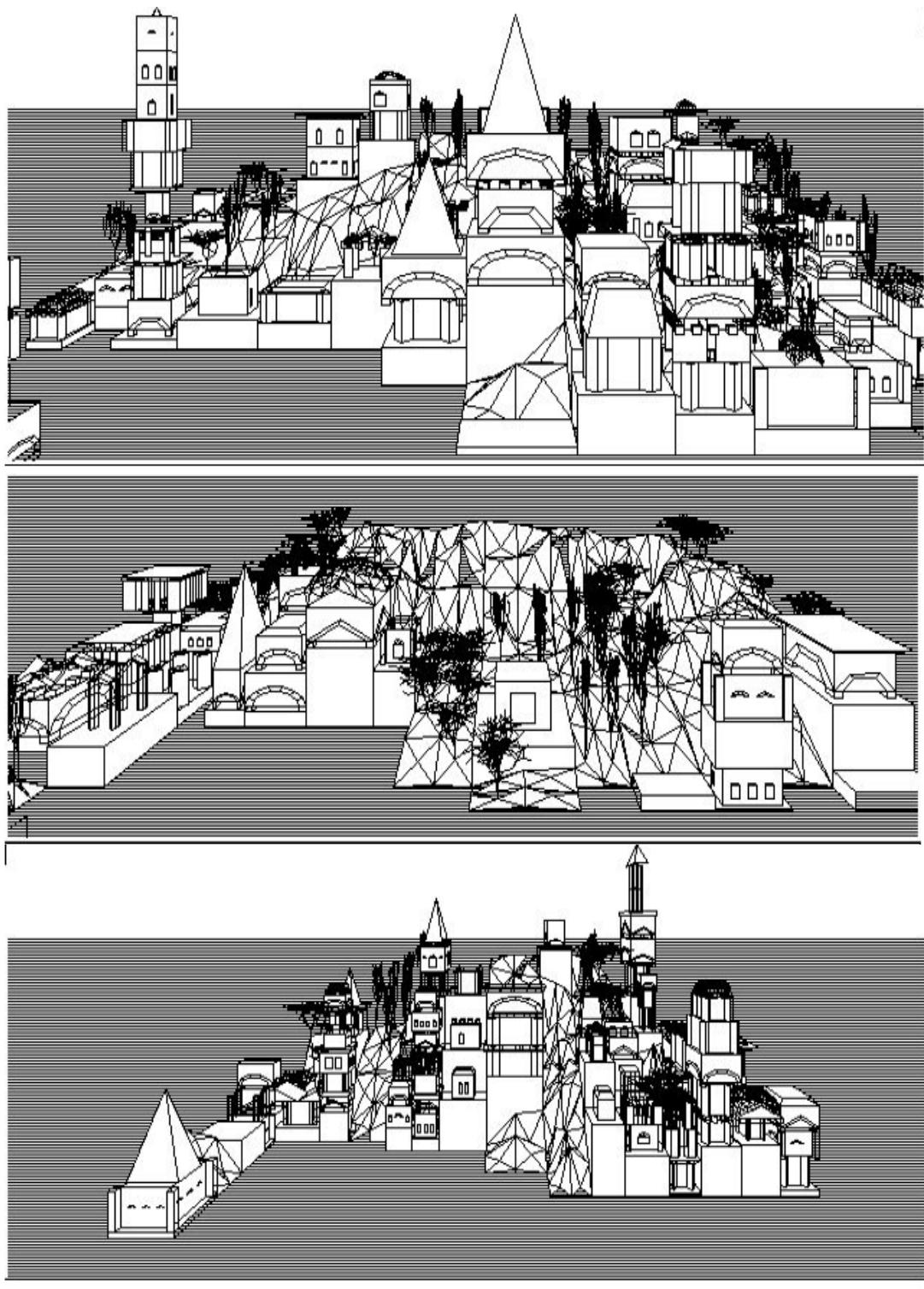
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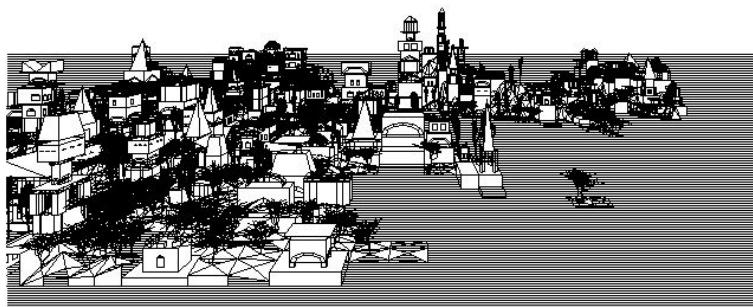
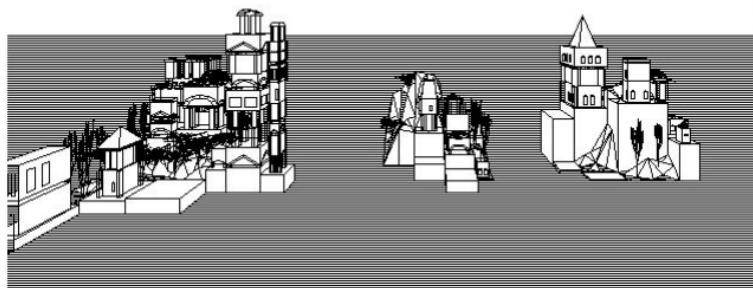
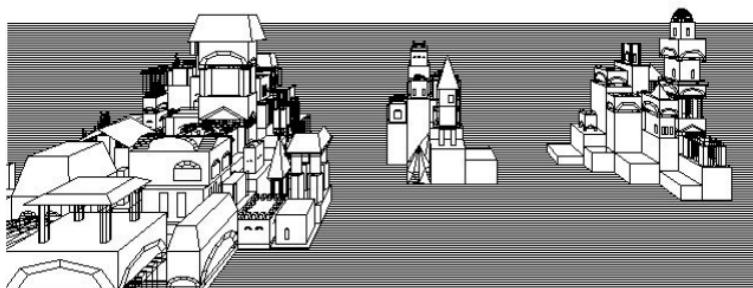




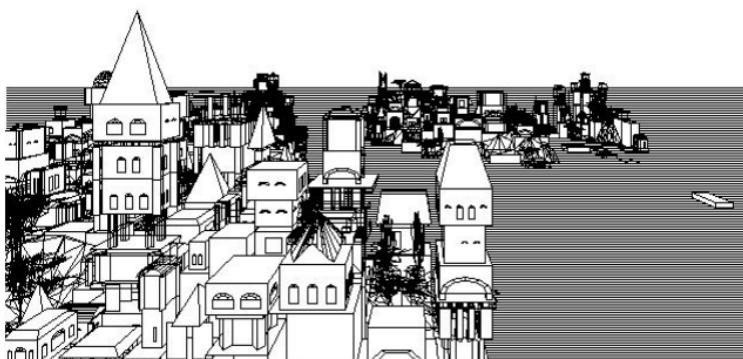
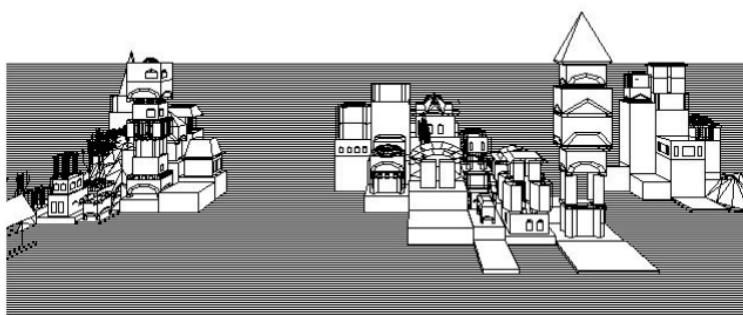
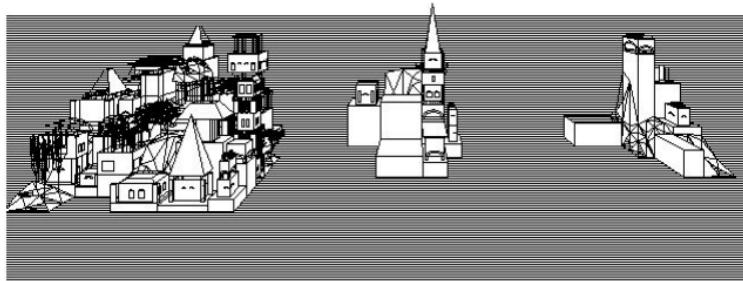


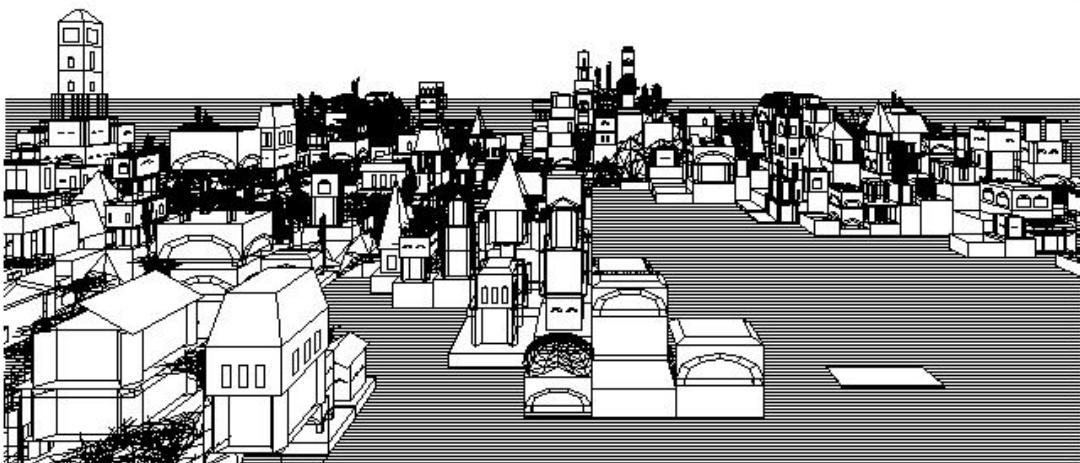
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The evolutionary history of this species project has been long and has gone through a concrete growth of the subjective imagery of reference. The scenarios that the project, in its initial phases, generated were always too much tied to concrete situations, to too categorical personal memories. The compositional evolution, its design history, was marked by the growth of complexity of these references, by the subsequent acquisition of this subjective imaginary. The initial operation, therefore, was not to raise the quality of the product but to raise the quality, as a widespread appeal, of the references. Which are, then, the yardstick, by difference, of the quality achieved by virtual environmental scenarios.

This has led to an overall refinement of objectives. This was until the initial contingent references were no longer detectable as the truth from which the falsifications

implemented through simulation could be deduced. Decaying and evaporating the truth of reference, the virtual scenarios of our possible world really became what they should have been from before: an imaginary of measurement of quality plausibly subscribable by many, an imaginary of reference plausibly intersubjective and "meta-projectural".

Projects of species similar in many ways to the previous one are the project Isolabella and Atollo Metropolitano. The latter is built with the same urban evolutionary system, but with a different morphological/natural system that simulates the evolution of the context. This means that, if the trigger of virtual history is comparable to the previous project, the evolution of the image has a strong probability of diverging, even in a remarkable way.

The images of the three-dimensional models generated by the Isolabella project accentuate the possible coincidence of architectural and urban events. The reference context, built through a strong subjectivity of interpretation, is, of course, the islands on Lake Maggiore. All scenarios use architectural characters that simulate historical stratification, excluding some models that simulate possible "postmodern" images used in the 1980s architecture.

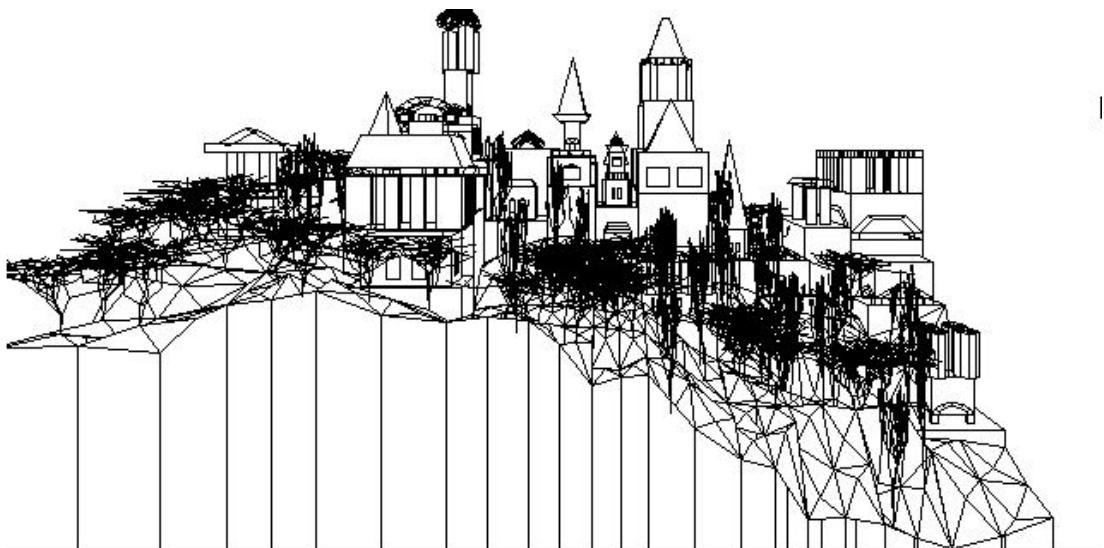
The last morphogenetic project of this series is the Metropolitan Atoll project, whose aim is to create an urban species with a very close relationship with the sea. Compared to previous projects, the metropolitan character of the city is accentuated, while maintaining a recurring architectural character that simulates historical stratification. As previously mentioned, the natural, in these virtual models, is not impervious but the land/water relationship is jagged and uses as a reference to the cities on the water of the upper Adriatic Sea.

The relationship, or rather the "difference" between natural and artificial is in all these projects, the supporting element. Just having considered (and designed) the natural together with the artificial has allowed considering, in these virtual environments, the two evolutions as parallel.

The environmental context is not something given, on which the city is superimposed, but is itself an evolving system, whose growth and transformation continues and interferes directly with the artificial. The two systems feed growth precisely from these exchanges, from these reciprocal contaminations and conditionings. And the temporal phase shift of the evolutionary cycles of the natural and the artificial trigger, in the overall history, resonances and reversals capable of accelerating and characterizing the identity of the place.

## **ENVIRONMENTAL SPECIES PROJECTS: THE BORGO**

THE MEDIEVAL VILLAGE, THE MEDIEVAL TOWN



*The greatest things in the world are done through others to which we pay no attention,  
small causes that we overlook and which eventually accumulate.*

*Georg Christoph Lichtenberg, "  
Consolation booklet*

"

The village built on the impervious top of a mountain, or on the steep slopes of the Umbrian hills, generates an extremely fascinating natural/artificial environment. And with a very high capacity to respond to human needs, so much so that very often these places are identified as examples of total quality.

The project of species II Borgo has this type of environment as a reference imaginary. An imaginary that, as always happens, has run through during the same elaboration of this project, its intrinsic evolution. Born from a desire to retrace, compositionally, the images of the fourteenth-century paintings and in particular those of Giotto, and from a subjective resurgence of images lived in medieval Umbrian cities, has, over time and the development of the same project, lost many of the characteristics, typically medieval styles [1]. This has developed the possibility to identify, systematically and synthetically, the ways of growth of complexity of the environment, of characterization of its image. Or rather, with the subsequent loss of the characterizations due to single

contingent forms, the formal logic activated for these simulations traced, representing them more and more synthetically, the specificities of the morphogenetic structure characterizing this specific genius locus.

The objective, however, has remained that of experimentally probing the capacity that this urban structure possesses to generate and preserve an image, identity over time. Operationally, the objective was to define and simulate the evolutionary system of the borgo, transcending the role of individual and ephemeral forms, equilibriums and static and contingent structural relationships which, however, were not considered as bearing the growth of complexity, the achievement of a recognizable image.

The virtual models that are generated by this project of morphogenetic code are, among them, always extremely different even though they respond to the same genius loci. Each one has, in its parallel history, different exceptional events, both in form and number; each model is born in a different natural context; the natural/artificial relationship is expressed, on the scale of the urban fabric, always in different forms.

What remains constant are not the forms, but their overall capacity for information. If we measured it, we would find that the amount of information contained in each three-dimensional model is comparable. The difference of information between the various models generated however exists, even if it does not exceed significant quantities. The average level is, however, high; and it has been possible to reach it just for the fact that no pre-constituted event catalogs have been used, but a morphogenetic type of information production has been activated. The information is generated, therefore, as in the natural DNA, through the resonance of simultaneous linear systems, a resonance that possesses characters of non-linearity, of unpredictability. [2]

This leads to producing much more information than "physically" contained in the project code because, by triggering non-linear dynamic processes, the final quantitative result is considerably higher. However, precisely because of the type of instrument, the quantity is probable, but not predictable.

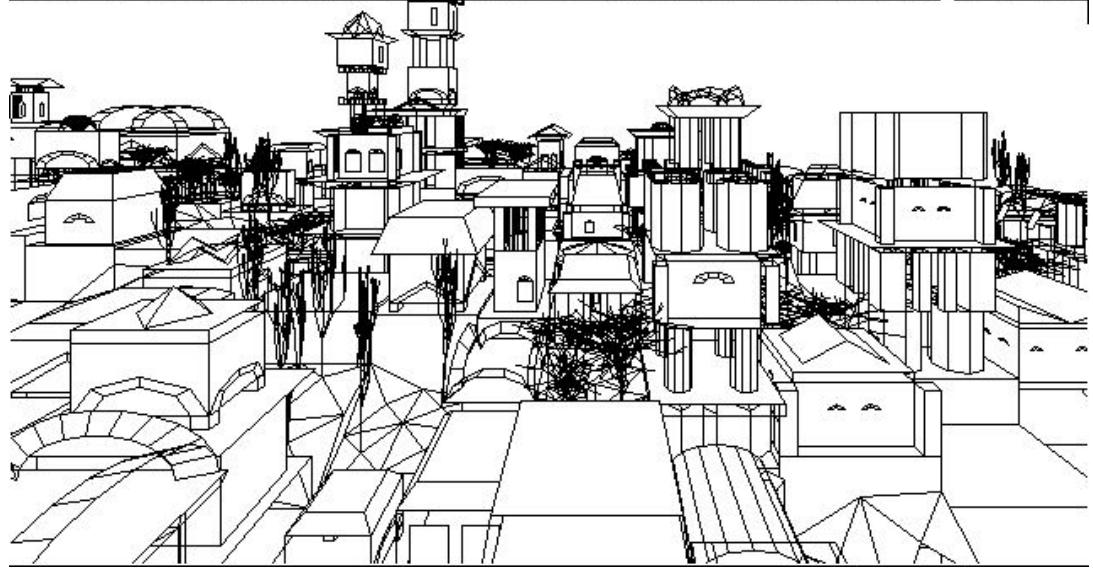
*Note 1. The models of Medieval Cities (created in 1989 and presented in the book Città Aleatorie, op.cit.) were generated through a morphogenetic code in which the medieval component was hierarchically more accentuated. In the Borgo species project, mediievality was transformed into historical stratification with a medieval trigger, while the environmental image component of the natural/artificial relationship was re-evaluated.*

*Note 2. If instead of using resonance between various sequences, the DNA contained information such as a database, a catalog of data, this would not be sufficient, in quantity', even for the storage of a small sequence of images. By using resonance between simultaneous sequences the information is sufficient for the realization of a living being and the management of its transformations.*

*In the next three images three models of Medieval Cities: in the following pages a series of models generated by the project of species II Borgo.*

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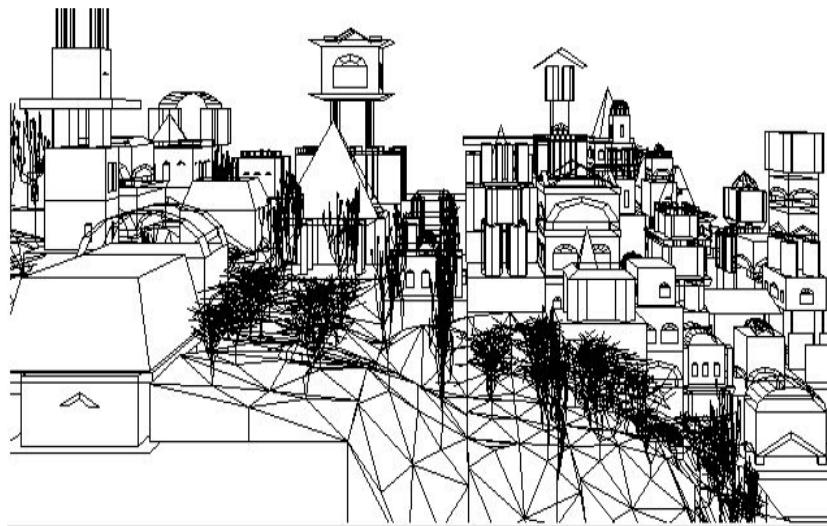
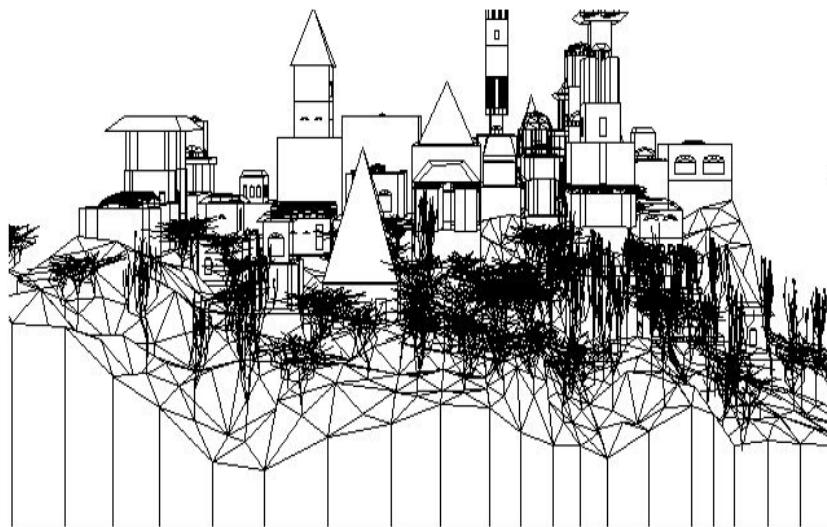
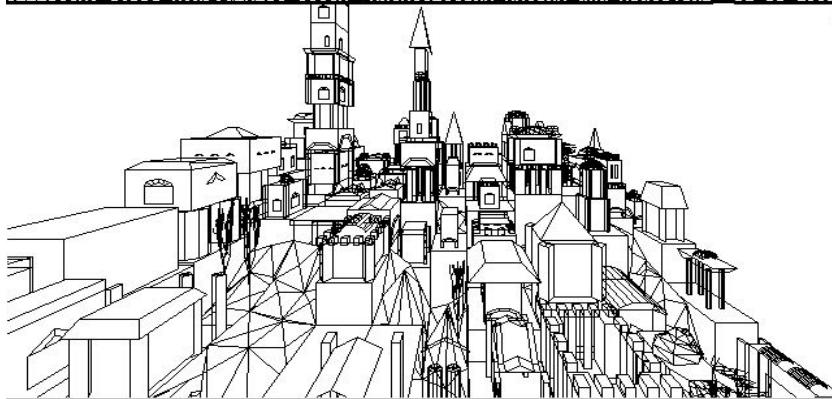
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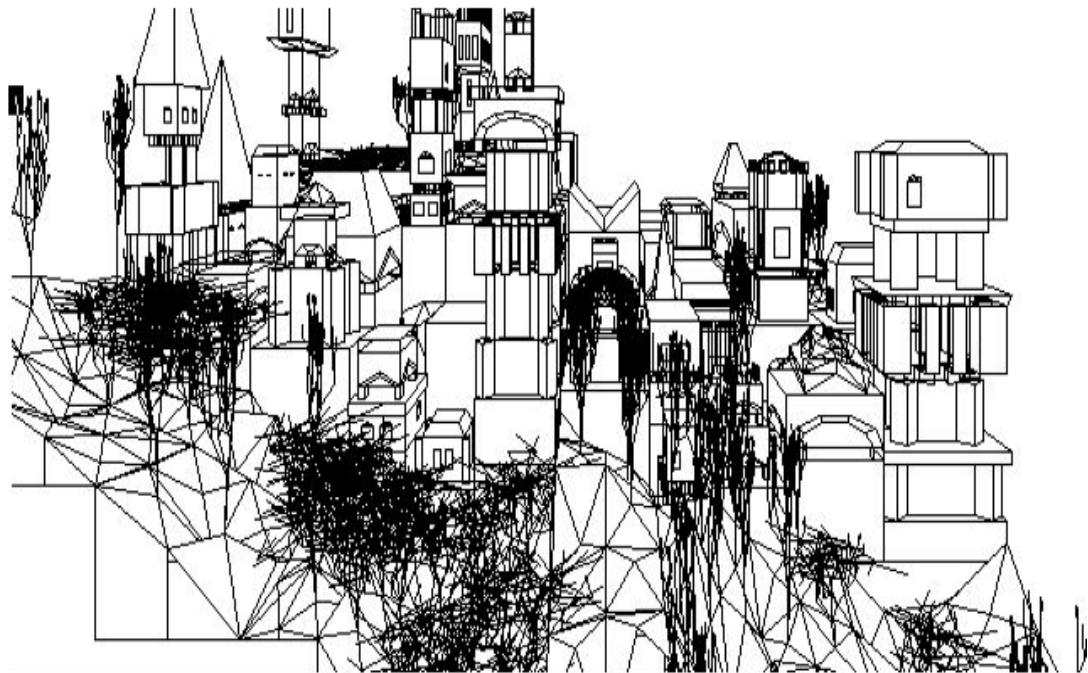
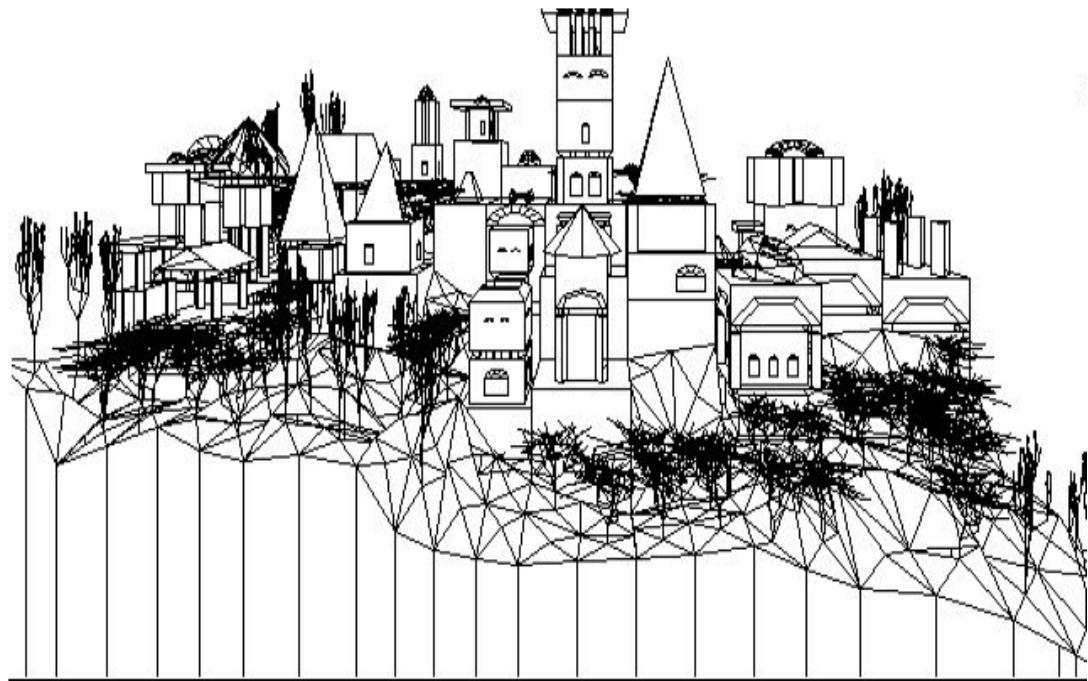


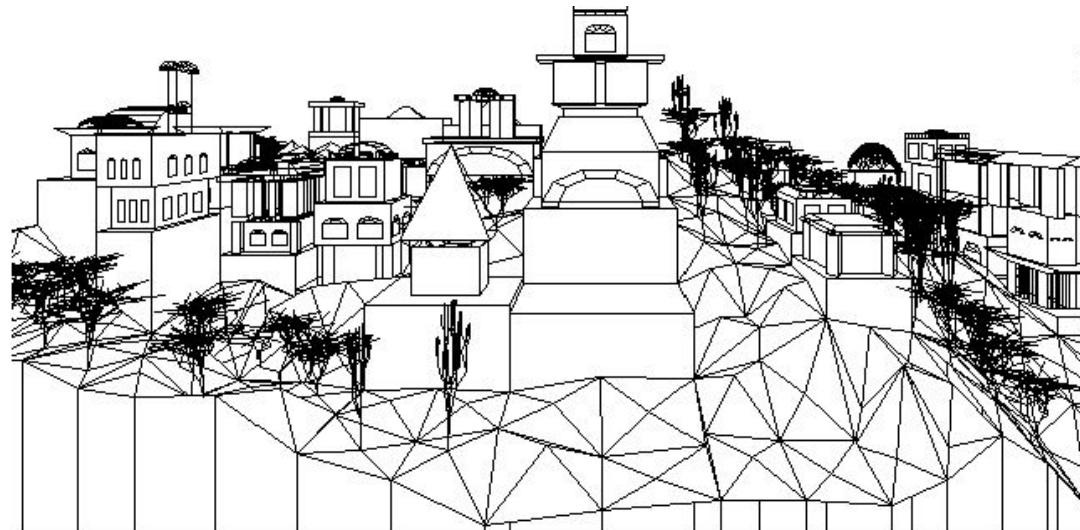
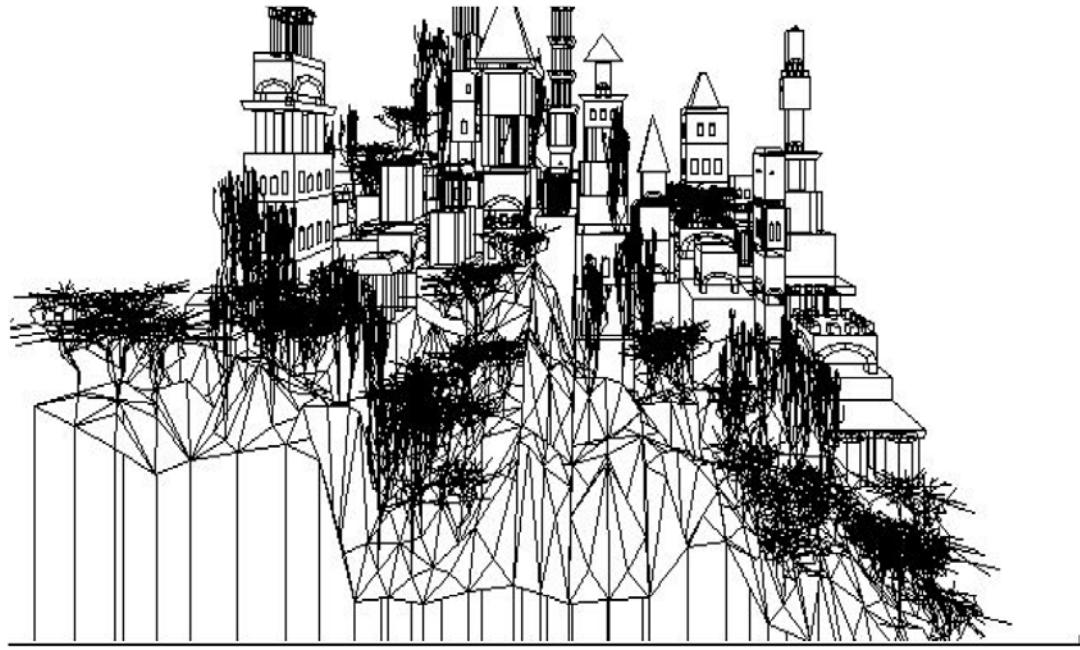
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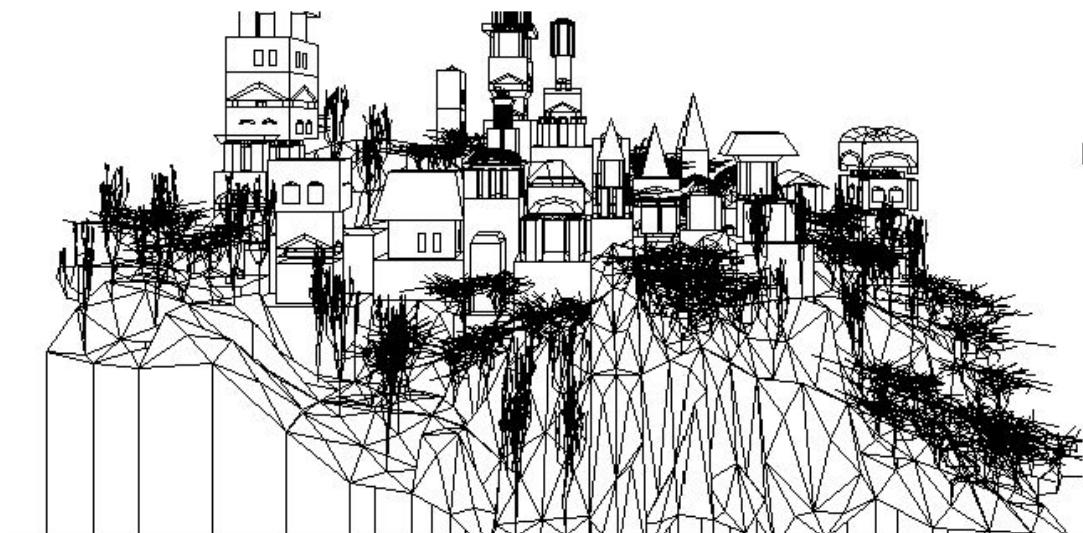
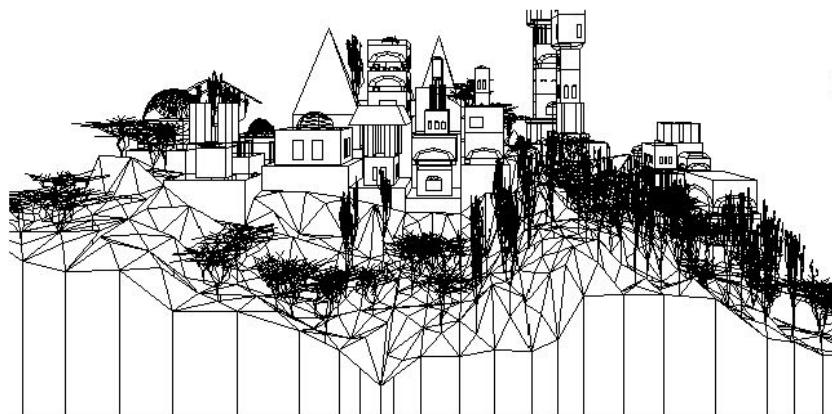
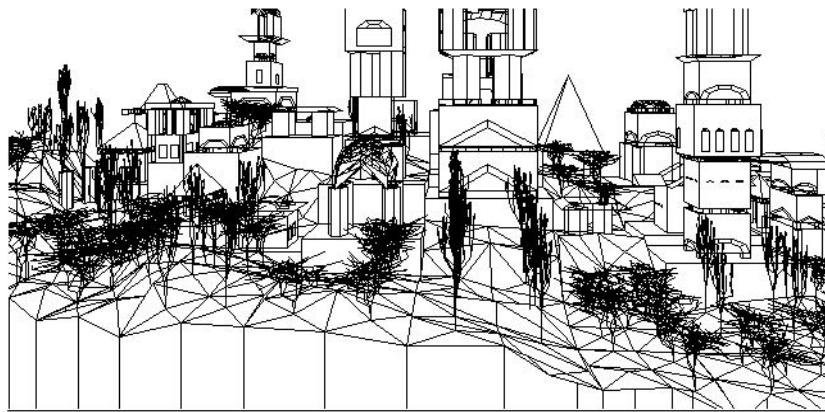


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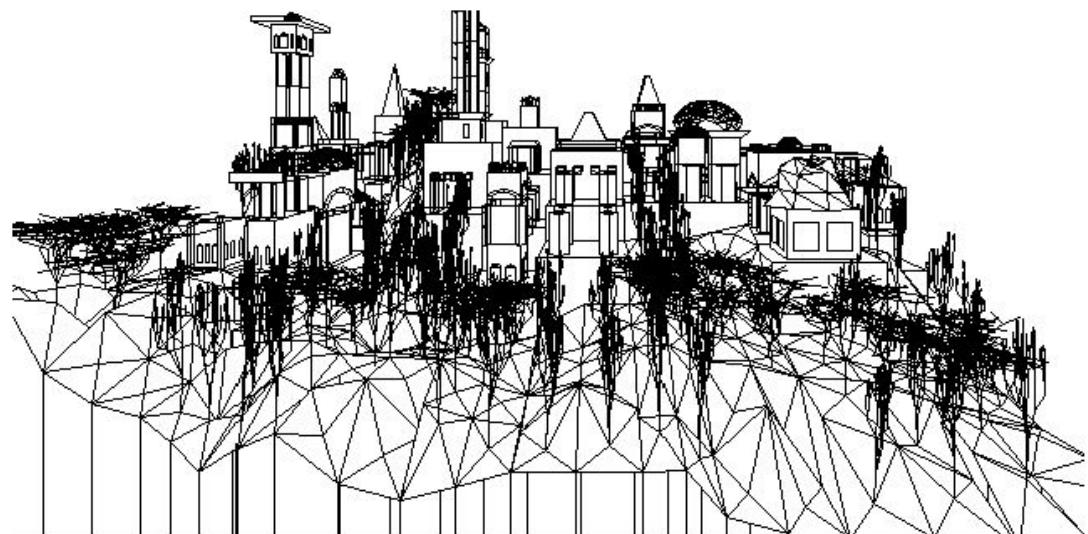
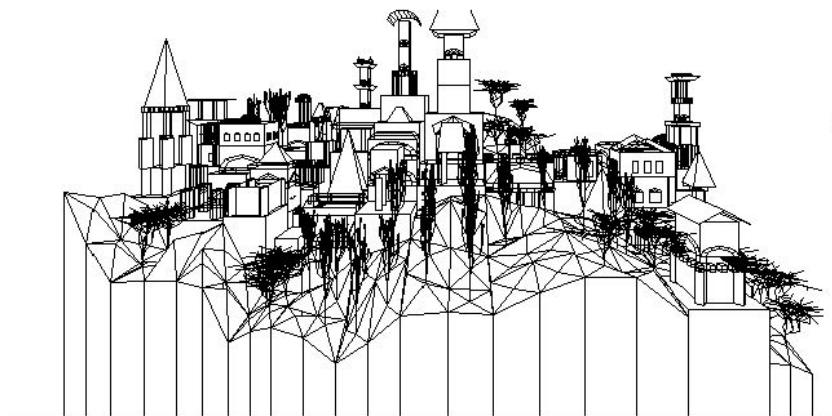
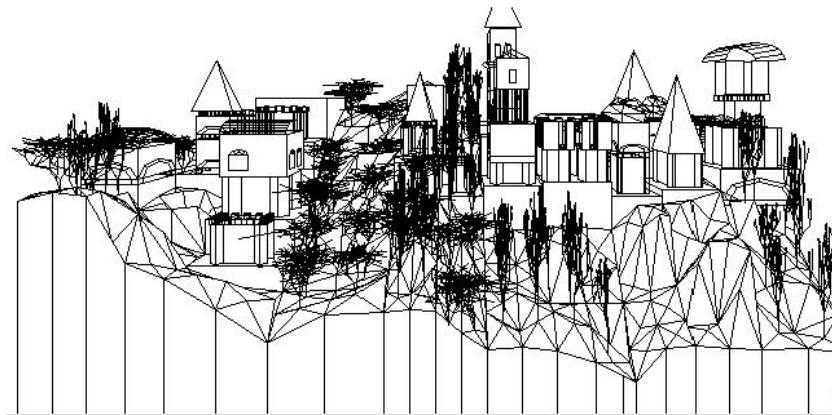




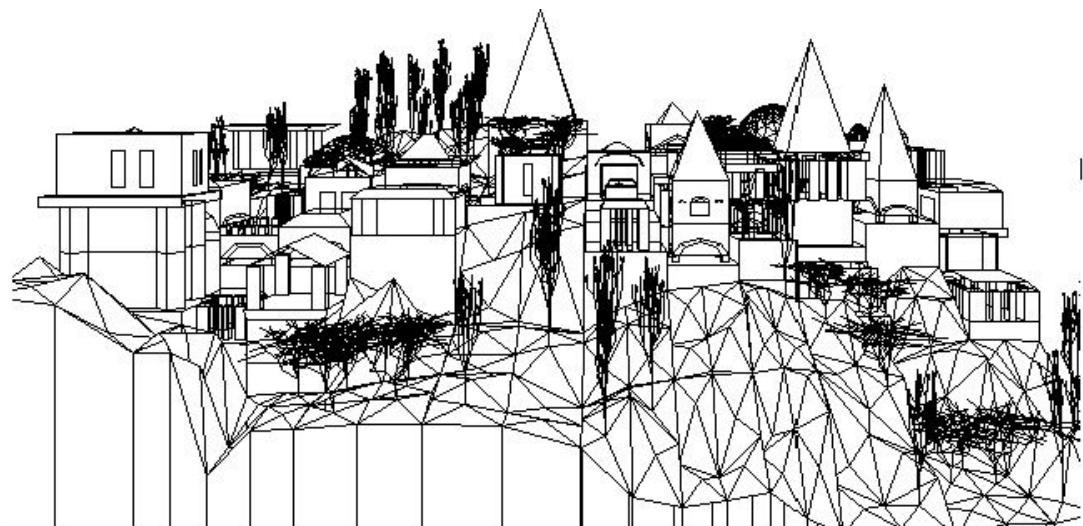
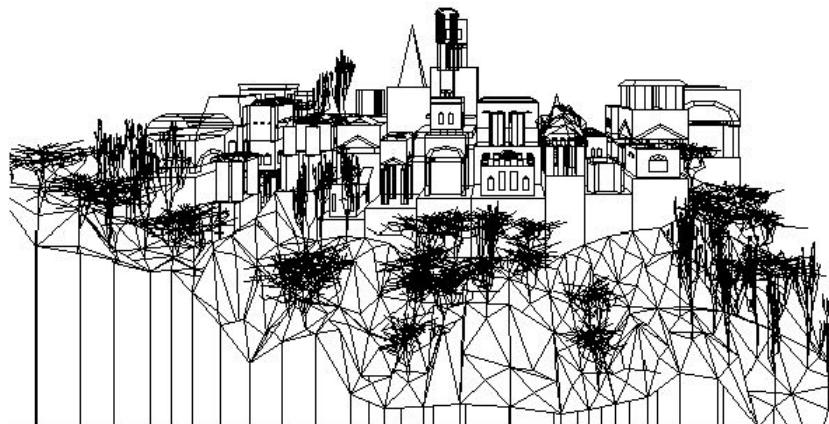
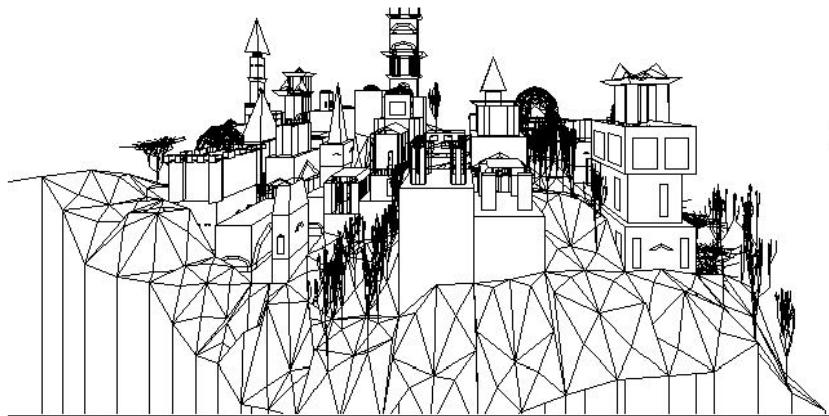


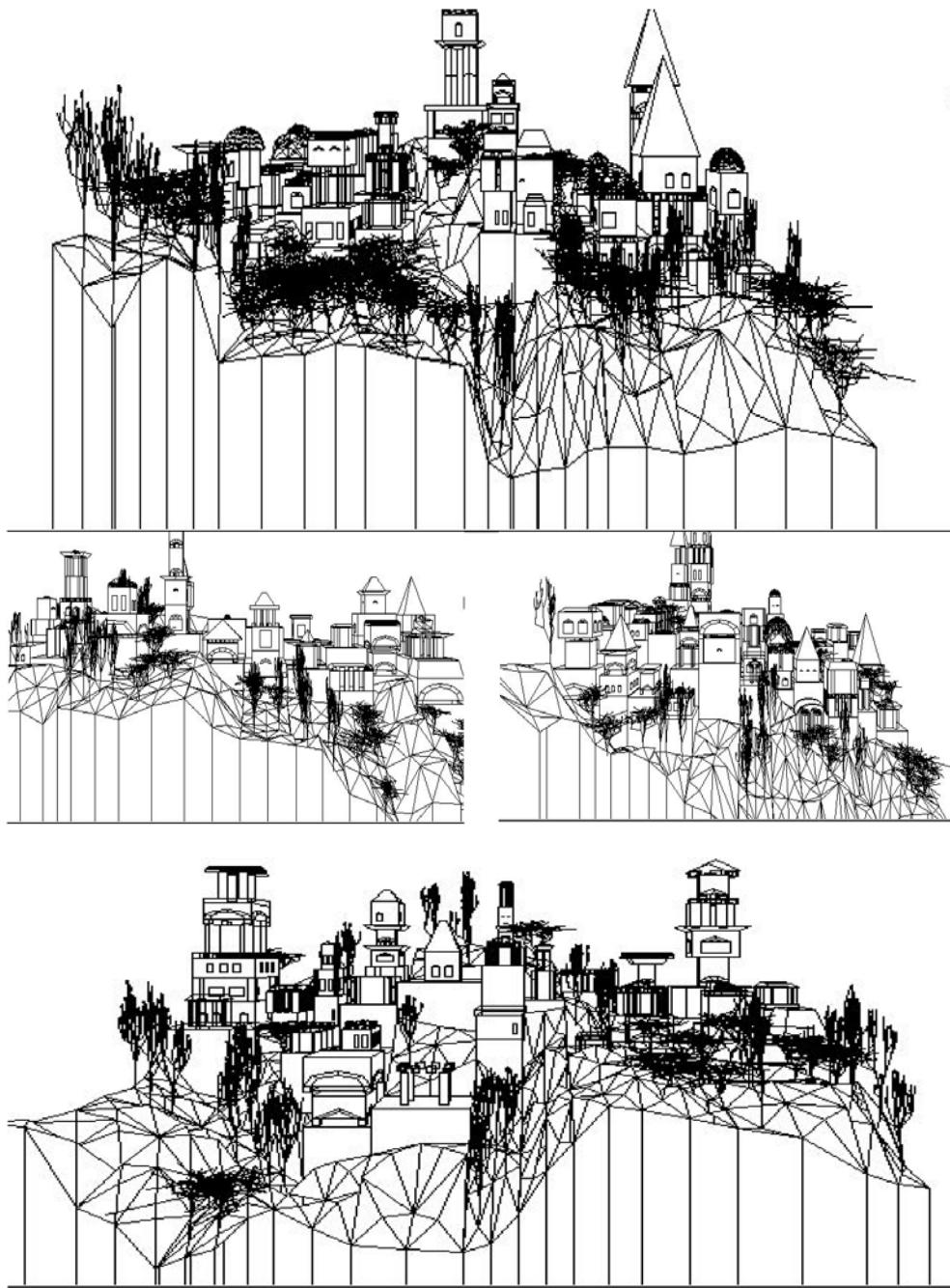


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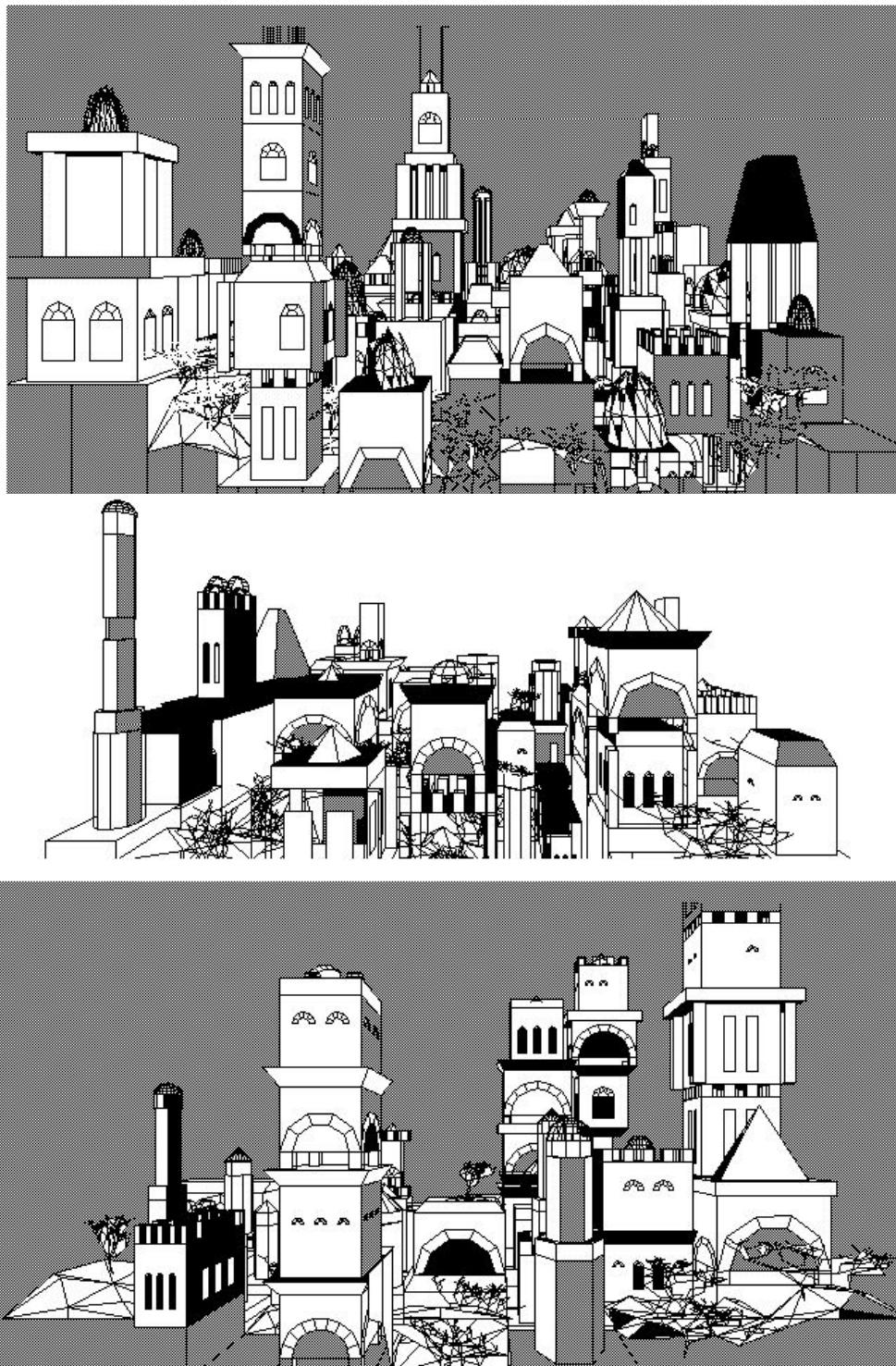
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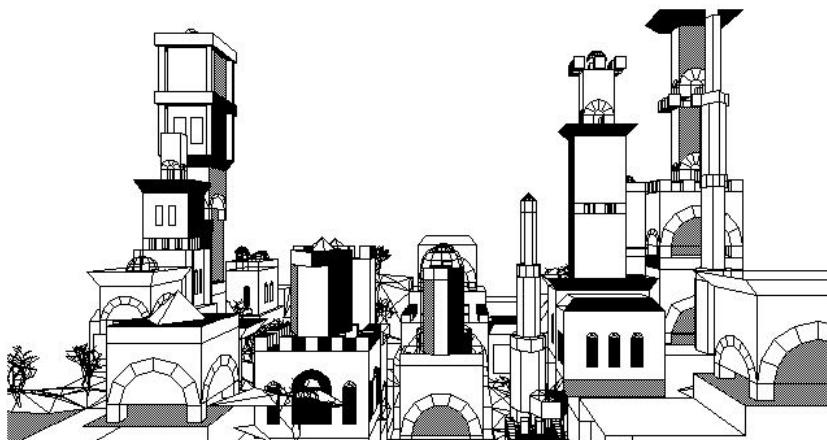
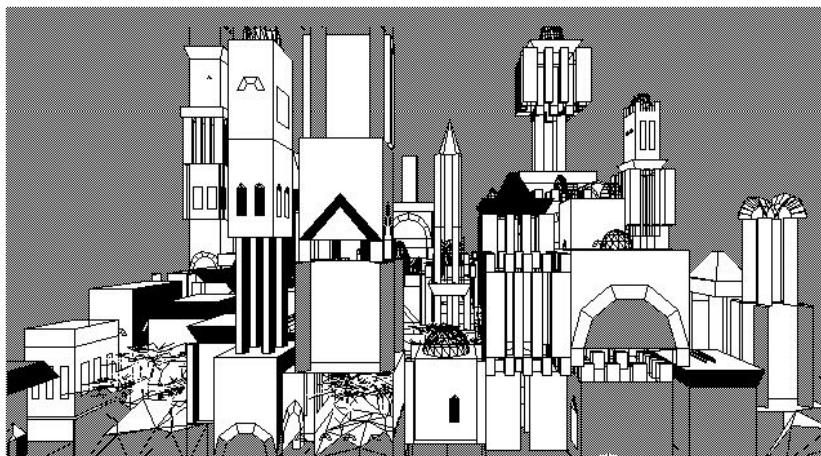


The images on the previous pages are representations of three-dimensional models of virtual environments generated by the morphogenetic code project *Il Borgo*. In these last three pages, instead, the represented models have been generated by the project *La Città Medievale*.

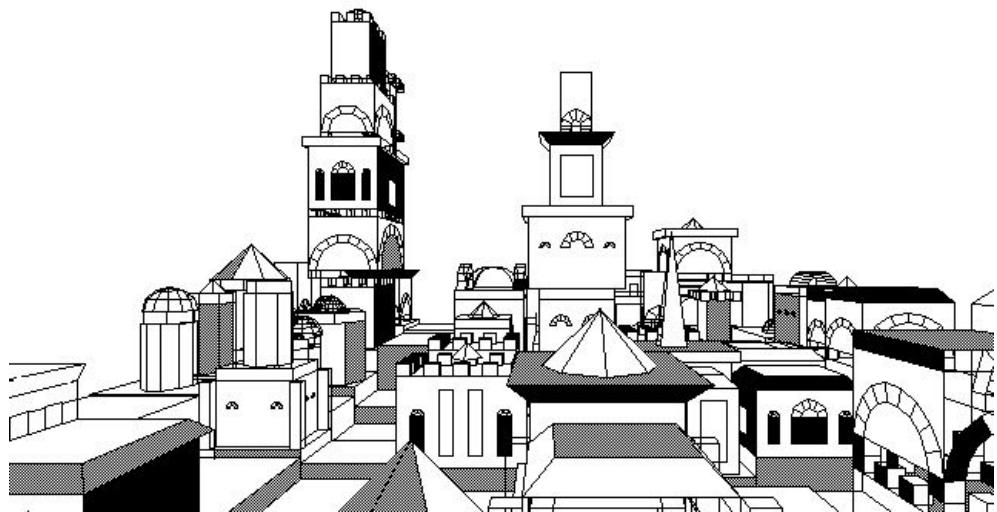
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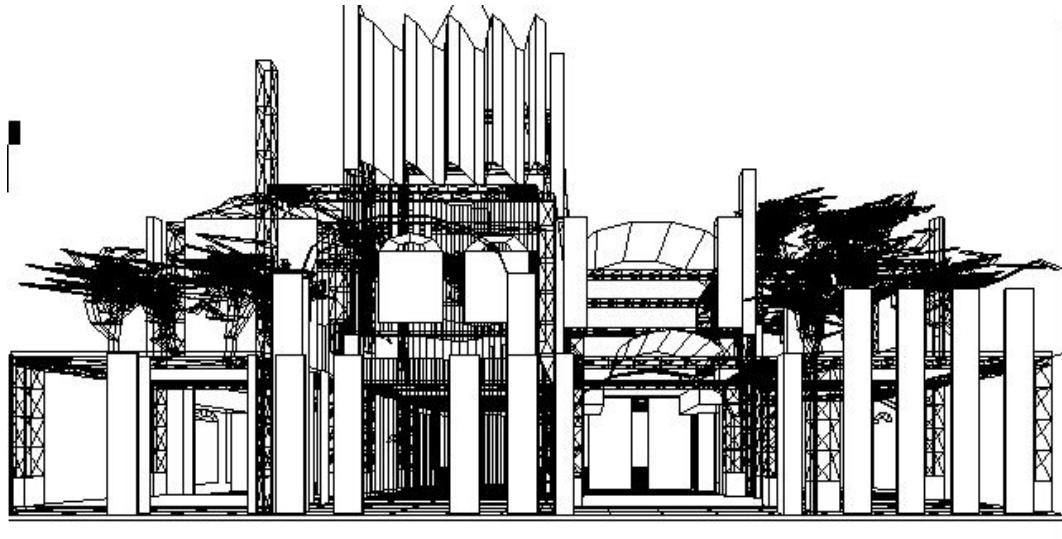
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## PROJECT TERME



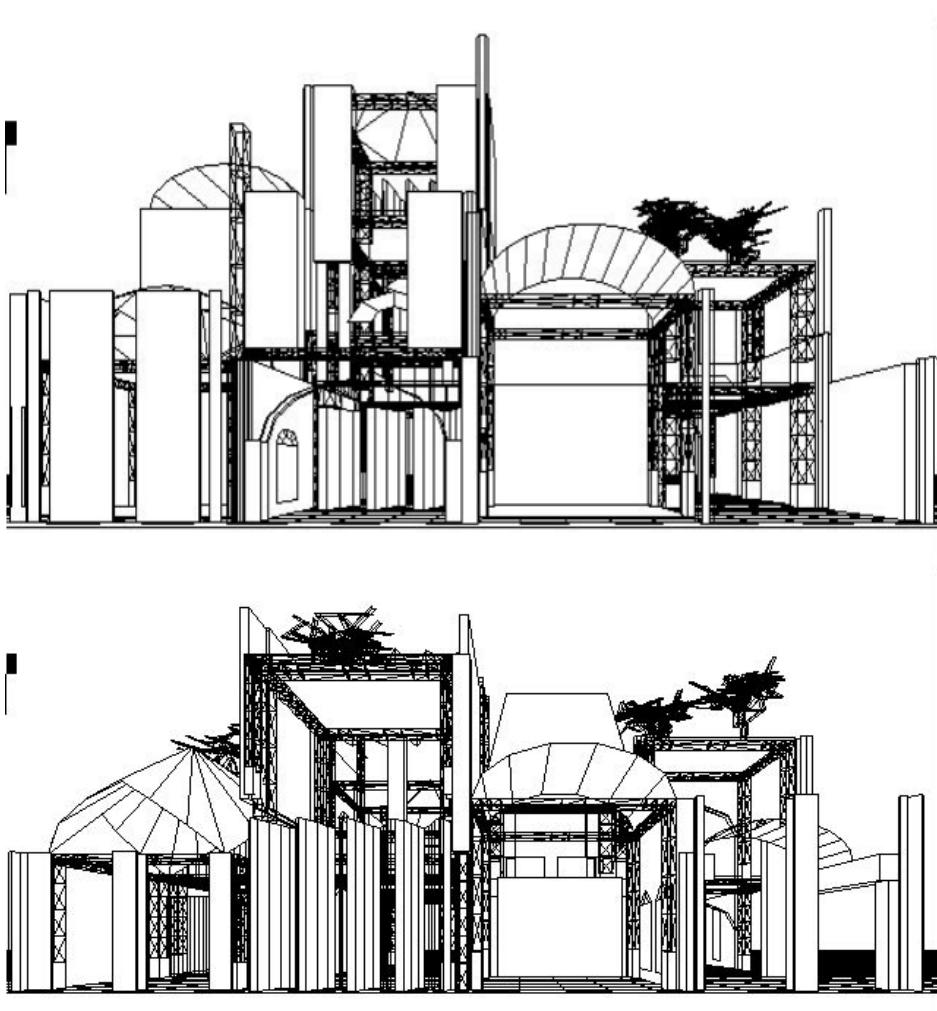
*But if you wish, by prolonging life, to benefit men truly; find art by which their sensations and actions are multiplied by the number and by their gallantry. In this way, you will properly increase human life, and by imploring those immense intervals of time in which our being is rather hard than living, you can boast of prolonging it. And this without going in search of the impossible, or using violence to nature, but rather by following it.. "*

*Leopardi, "Operette morali", dialogue between the physicist and the metaphysicist*

The Terme project is a project of species, operated specifically in the architecture. The design defines a Formal Genetic Code of an artificial environment with specific characteristics, the ability to respond to the needs of human life.

The project is made explicit as an original software that generates, on request, virtual models of artificial environments always different individually, but whose characterizing structure is recognizable by the species to which it belongs, which reflects the design logic adopted.

BASIC PARAMETERS FOR THE GENERAL DEFINITION OF THE DESIGN OPPORTUNITY.



1. FIELD OF PRACTICAL FUNCTIONS

\* The architectures generated must be adaptive, therefore available for multiple uses that include tertiary structures in general; in particular they must be suitable for uses such as service centers, shopping centers, etc.

The typology of the volumetric stereometry of the architectures that can be generated must be composed of a central, more consistent core and a directly connected, less volumetrically important surrounding. The structure evolves on several planes, with a typological/constructive characterization for multi-level units strictly connected vertically and connectable with interchangeable interfaces on the vertical plane.

2. FIELD OF SYMBOLIC FUNCTIONS.

\* Stereometries and geometric matrices of every single space that can be generated must be structured as an all-inclusive medium; [1] will, therefore, be characterized on the symbolic plane as containers available to communicate and amplify possible and futuristic meanings.

\* The logic of the sequences between spaces, and of the possible virtual temporal paths through them, must respond to the same criteria of adaptability of the previous point, therefore to a willingness to support subsequent, contingent and unpredictable meanings/uses.

\* The formalization of the interfaces between spaces must characterize and amplify, but not categorize, the choices related to the two previous points.

### 3.. FIELD OF AESTHETIC FUNCTIONS.

\* Each formal event, within the possible virtual architectures generated, must be characterized, as an image, by a precise placement within the scale of ability to generate an order. The availability of the possible placements is defined as percentually and structurally, but this pre-determination is dynamic and can change during the generation process in relation to particular exceptions. This hierarchical scale covers an arc that goes from the capacity to generate order only in spatially and temporally (project time) neighboring events, to a capacity of interference with long-range order. The location/measurement of the image of each event also defines one of the components of its exceptionality.

\* Each formal event is accepted (as an image responding to the objectives) only after having lost its categorical features, due to the randomness/subjectivity simulated in the process, and having acquired a capacity of aesthetic response with plausible values of intersubjectivity. This process of purification of categorical debris towards an intersubjective opening [1] occurs through the iteration of the formalization cycle. This procedure re-inserts as the input of the repeated formalization cycle, the previously formalized output, and this for an appropriate number of times. Moreover, to access a possible subjective multiplaterality of aesthetic appreciation, the same formalization cycle, each time it is iterated, varies using the same generation devices, but according to different sequences and hierarchical parameters. This implies that, after some iterations of the process, the categoricity of the random/subjective input is purified, and the image acquires a capacity of intersubjective response.

\* A restricted management of exceptions is activated in this project of species: no exceptions are accepted such as to interfere with the overall order of the architecture, but only exceptions such as to characterize and identify the individual events/spaces.

### 4. FIELD OF SUBJECTIVE CONCEPTUAL NEEDS. CHARACTERIZATION OF THE SPECIES AS A SUBJECTIVE LOGIC OF APPROACH TO THE PROJECT.

It is defined as subjective imagery of reference through which it is possible to measure the quality of the project development. The quality achieved is in fact measured as a reduction of the arrow between the virtual reality of the project and the reference imaginary.

This imaginary is not structured through stable connections and syntheses between

different fields, which would affect productivity, but is a subjective collection of design readings of reference environmental situations.

For the TERME species project these are:

- \* The structural/symbolic warp and the complexity of the Roman thermal baths.
- \* The happy case [3] that, as in the urban image of Rome, reaches a very high capacity of fascination.
- \* The spatial sequences of the suq and contemporary shopping centers.
- \* Some nostalgia for high tech architecture, and an interest in the spatial textures of three-dimensional steel structures.
- \* The natural/artificial mixture/contamination. With the artificialization of greenery and the naturalization (or rather a fractalization) of the artificial; with the subsequent invariance of the scale of geometric complexity.

## 5. FIELD OF CONSTRUCTIVE, TECHNOLOGICAL AND MATERIAL CONGRUENCIES

This field was approached with the choice to activate congruence grids that would select acceptable formalization choices based on their constructive plausibility. The use of a grid of verification of the choices in progress, and not of a direct proposal of the possible alternatives, has been adopted according to the specific options of this project. In this case, in fact, the above-mentioned image references have been (subjectively) considered hierarchically more incidental to the achievement of the set objectives than the presence of a broad spectrum operation on the technological options. This with the exception of certain structures and materials, such as steel spatial structures, which, being directly an essential part of the adopted reference imaginary, enter autonomously into the devices of formalization of architectural choices.

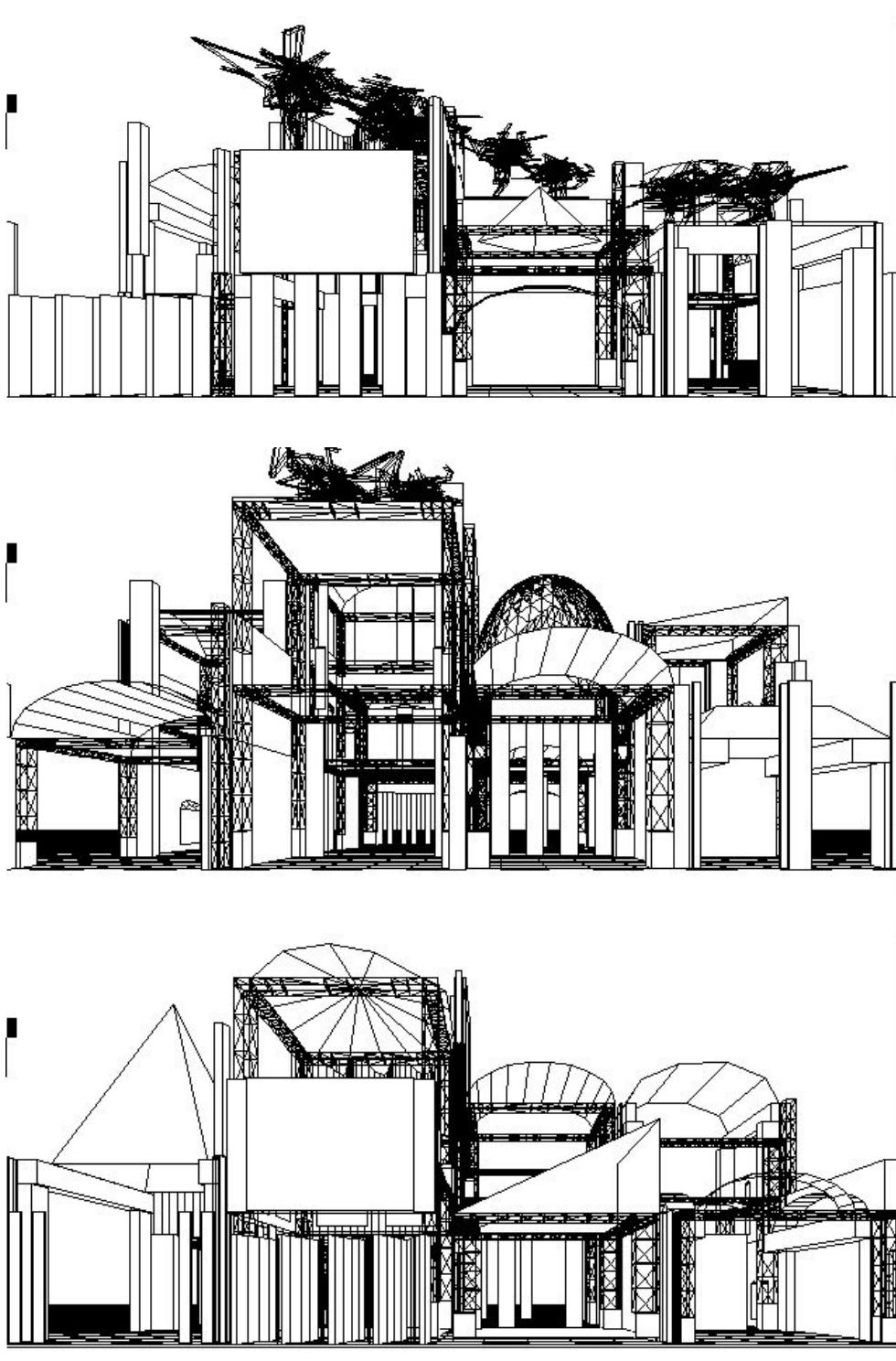
In particular:

- \* Activation of a congruence grid that accepts, as a norm, a construction form based on the weft of pillars and beams. And only exceptionally accepts overhangs and inclined supports.
- \* Grid of congruence of the stereometry of the roofs that forces the derogation from normality (accepting up to eighty percent of non-roofed roof forms). All forms constructively referable to historical stereometries are accepted (vaults, domes, pyramids, etc.), and, even if exceptionally, different formal events (such as fractal domes) as long as they are technologically plausible using steel spatial reticles.

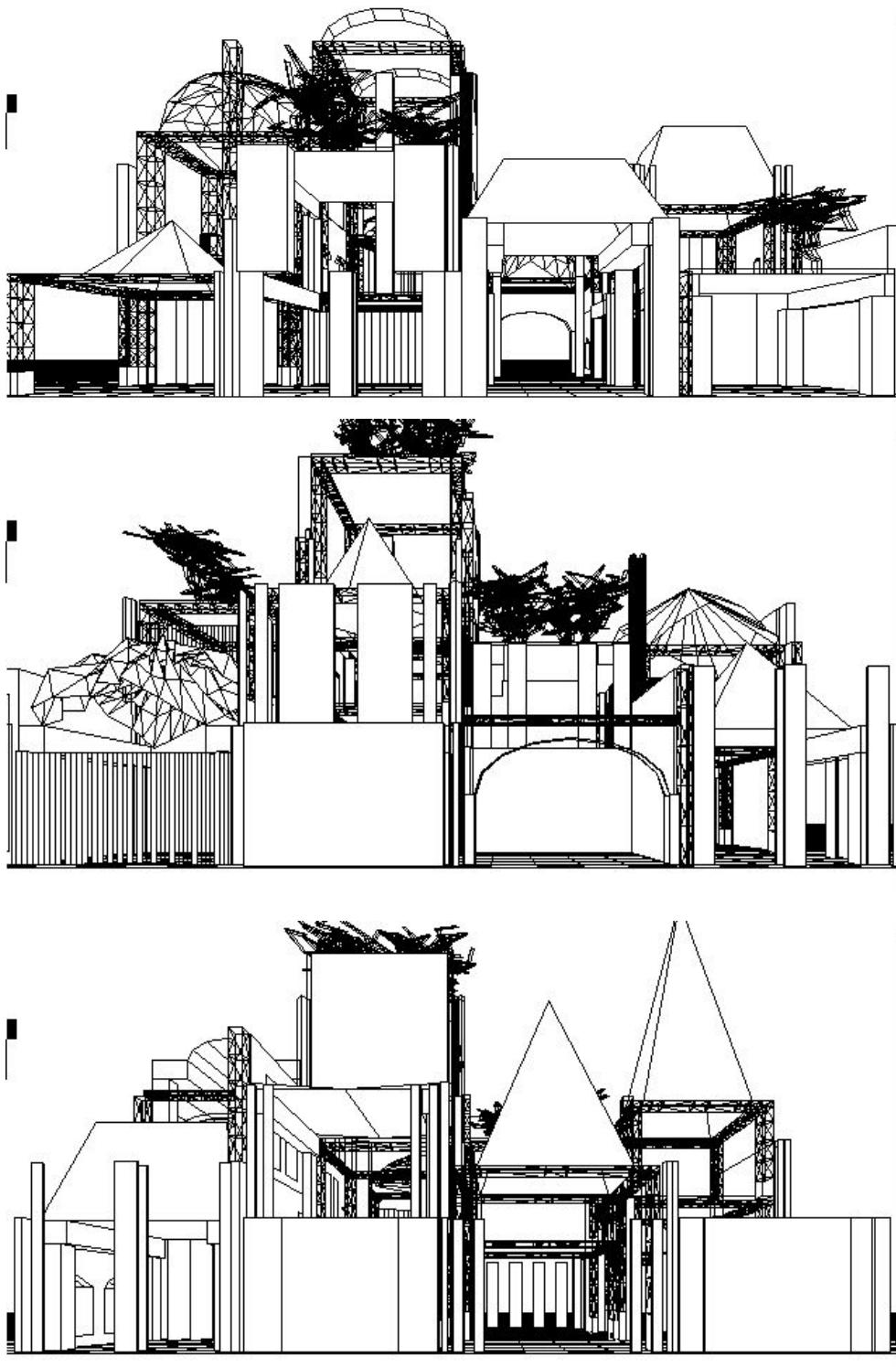
\*Grid of congruence that strengthens, making them interchangeable in choices, elements in reinforced concrete and steel spatial structures. This generates the possibility to use steel without further constraints (e.g. the economic factor) whenever it can be useful to the complexity objectives activated.

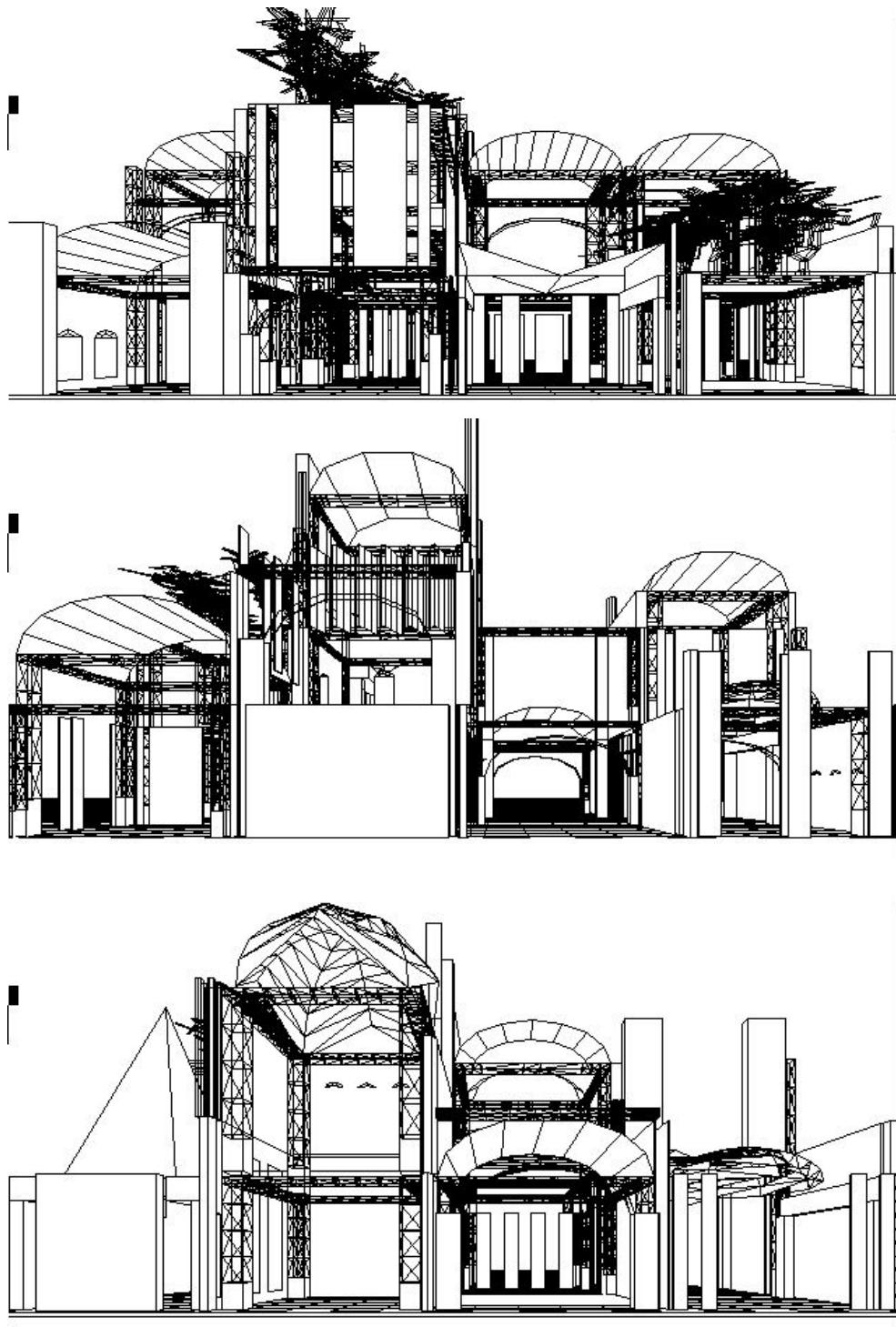


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CONSTRUCTION OF ARCHITECTURAL MATERIALS, AS GENERATION DEVICES

(DNA)

The species project does not use lists of components, since a catalog of existing elements would, firstly, be too small in number, and secondly, it would presuppose the impossibility of the unforeseen. On the contrary, a species project is a dynamic system with unpredictable development, which has as its structural premise that it never produces two identical individuals. Also because if two identical individuals were born, the system would enter a repetitive cycle, all the following individuals would also be repeated in the same previous order, and the system would become closed.

Instead of catalogs or databases, linear evolutionary procedures of forms are used. Each of these procedures is, in itself, predictable. But the simultaneous use of these linear systems produces, for the well-known phenomenon of resonance, non-linear dynamic systems, therefore with a character of unpredictability. [4]

It is the same structure of natural DNA that uses the resonance between two signal chains to communicate a large amount of data, which, individually, could not produce so much information.

The morphogenetic materials/procedures used simultaneously in the project are:

\* Form evolutionary procedure, composed of a series of simultaneous procedures, which operates in the transformation from the plane to the fractal dome without interruption, if not for a whole series of successive bifurcations that structure the unpredictability of the evolutionary dynamics. This procedure is, therefore, already within it, chaotic and non-linear.

The procedure of genesis of successive geometries with margins of congruence (even exceptional) in the passage from one to another, and in the variation of scale. This procedure inserts, in the simulation of the choice of formalization, the variable of a possible progressive slippage from one geometric plot to another.

\* Procedures for checking the complexity in the next slippage of scale. This procedure controls the complexity (through the parameter of the quantity of information) in the relationship between detail and everything.

## DESIGN EVOLUTION CONTROL ALGORITHMS.

These logical procedures define the type of design approach activated, and trace the connotations of the species, upstream of the single possible architectures/scenarios that will be generated.

In particular, the logical procedures of formalization activated are:

- \* Procedures for the choice of spaces based on the irreversibility of previous choices.
- \* Procedure of choice of the construction parameters of the spatial sequences.
- \* Selection procedures and control of interface formalization.
- \* Procedures/grids of architectural and typological congruence.
- \* Selection procedures and control of the increase in complexity.
- \* Exception acceptance/denial procedures.
- \* Procedures for modification/overtaking the evolutionary paradigm following the acceptance of exceptions.
- \* Normal procedure of reference paradigm adaptation in relation to the evolutionary process of the project.

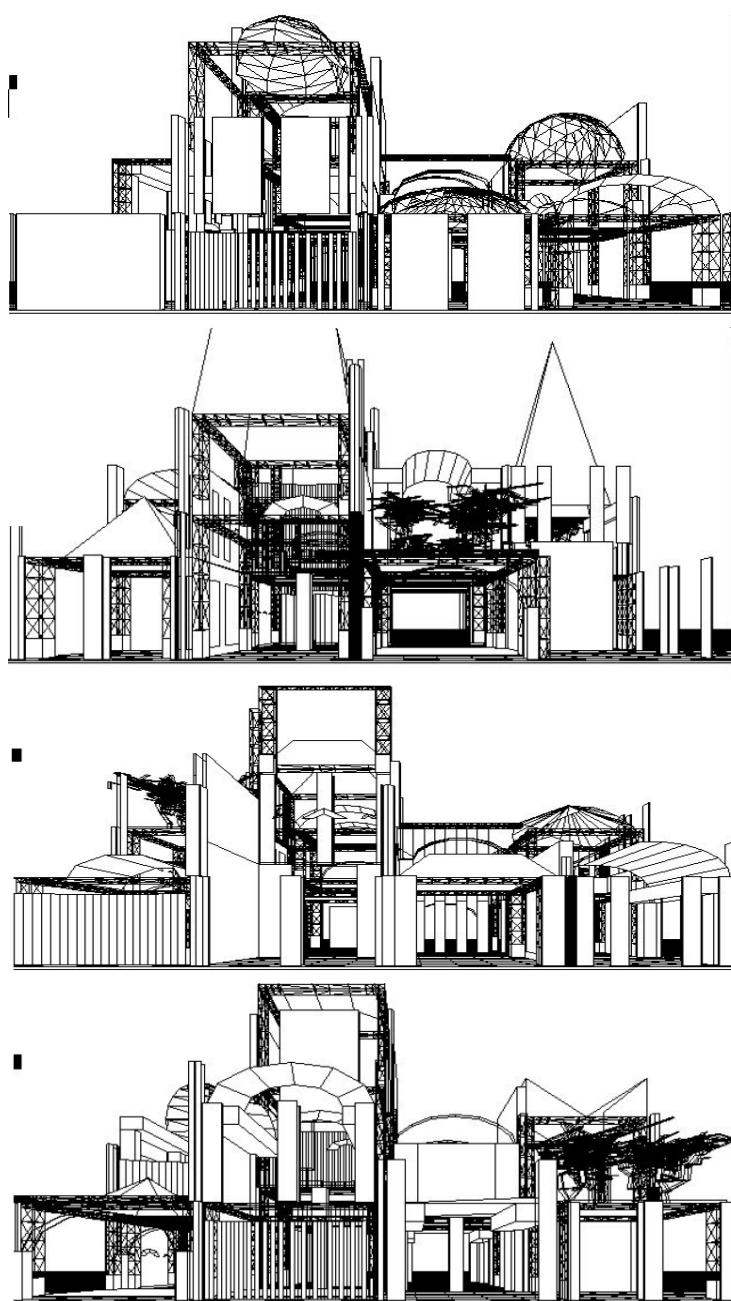
Note 1. Ernst Cassirer, "Philosophy of symbolic forms", La Nuova Italia 1964 (1923) Note

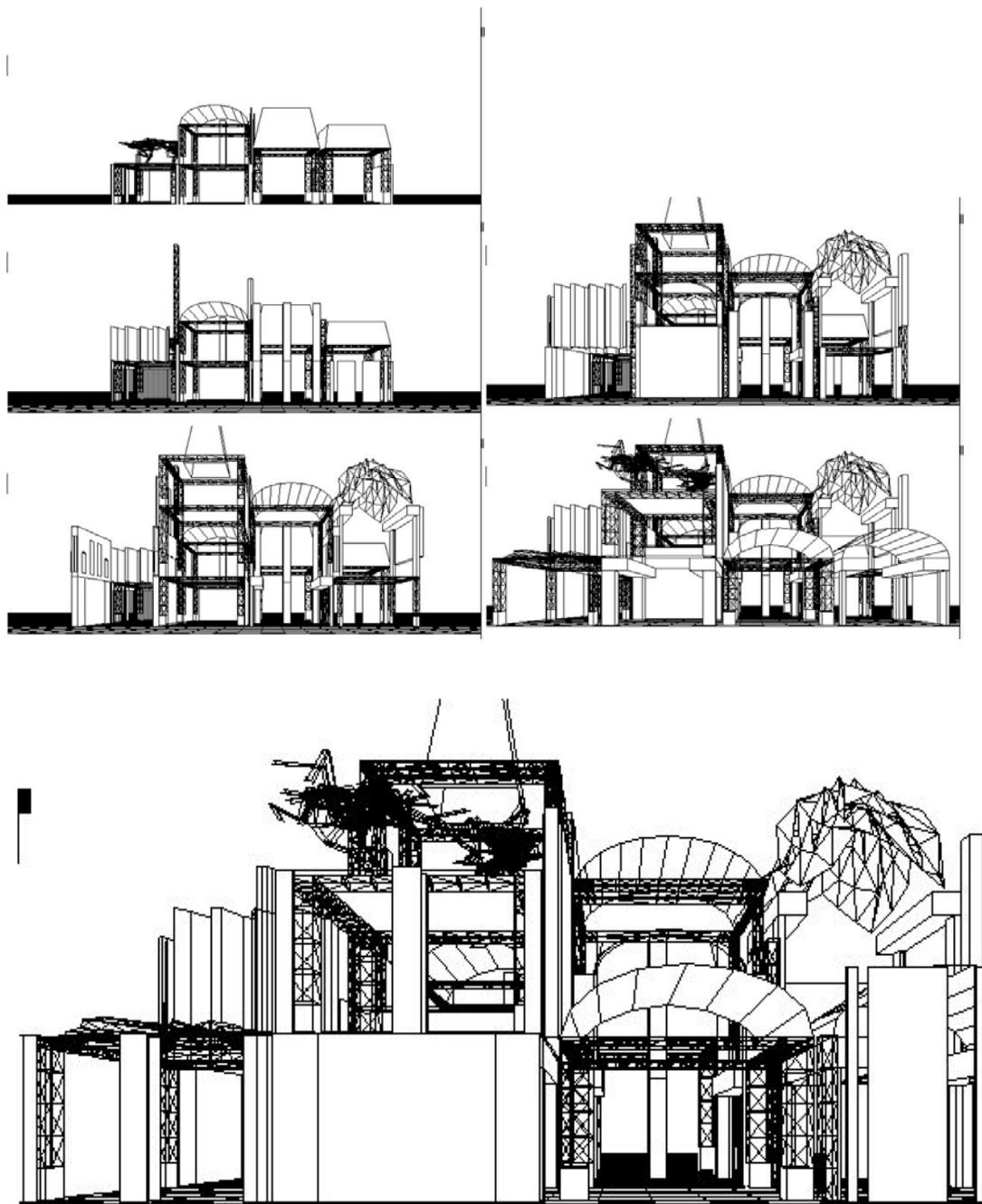
2. Umberto Eco, "Opera Aperta", Bompiani 1980

Note 3. Georg Simmel, op.cit.

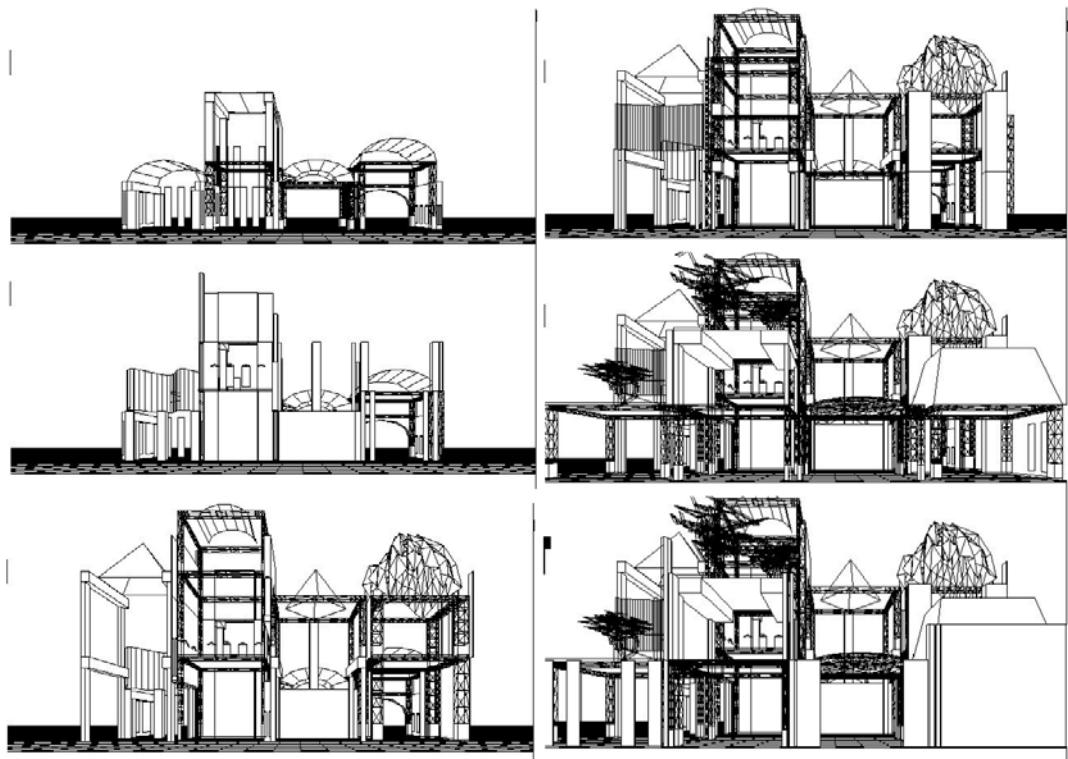
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Note 4. René Thom, *op.cit.*



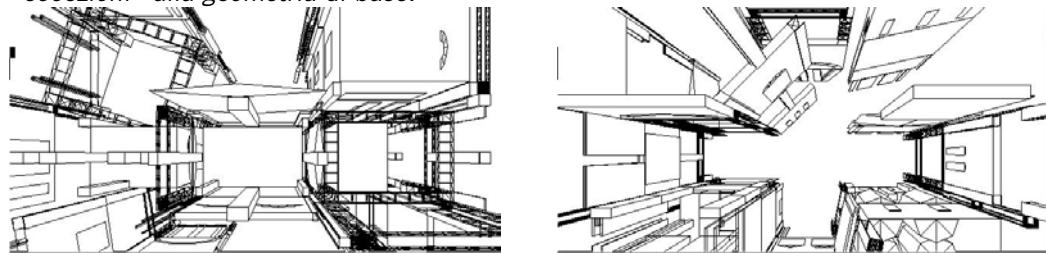


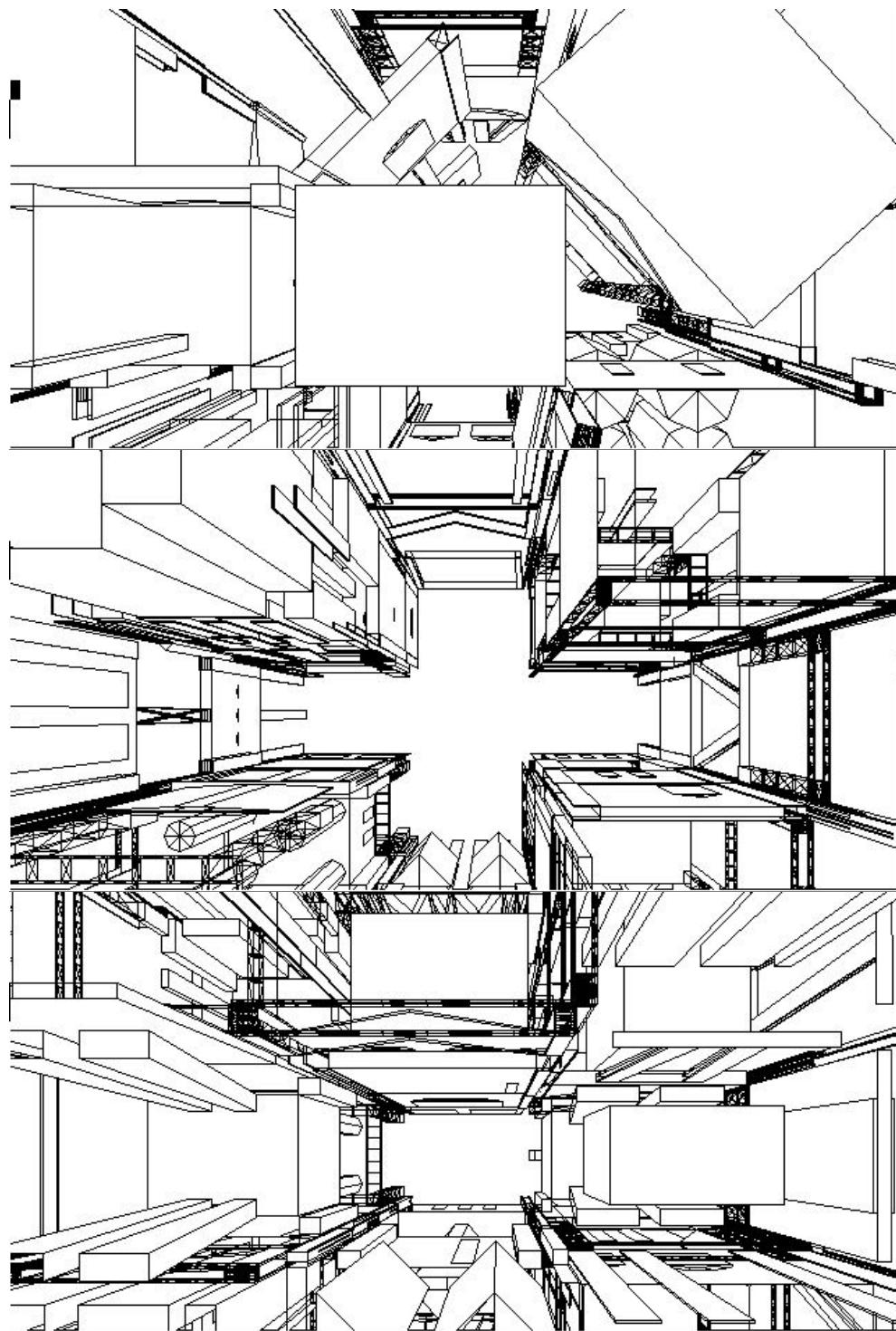
In the images Fig.1-6 Sequences of sections on the same three-dimensional model generated by the THERMAL species project. In the sequence of images the structure of the spaces and the formalization of the interfaces alternate.

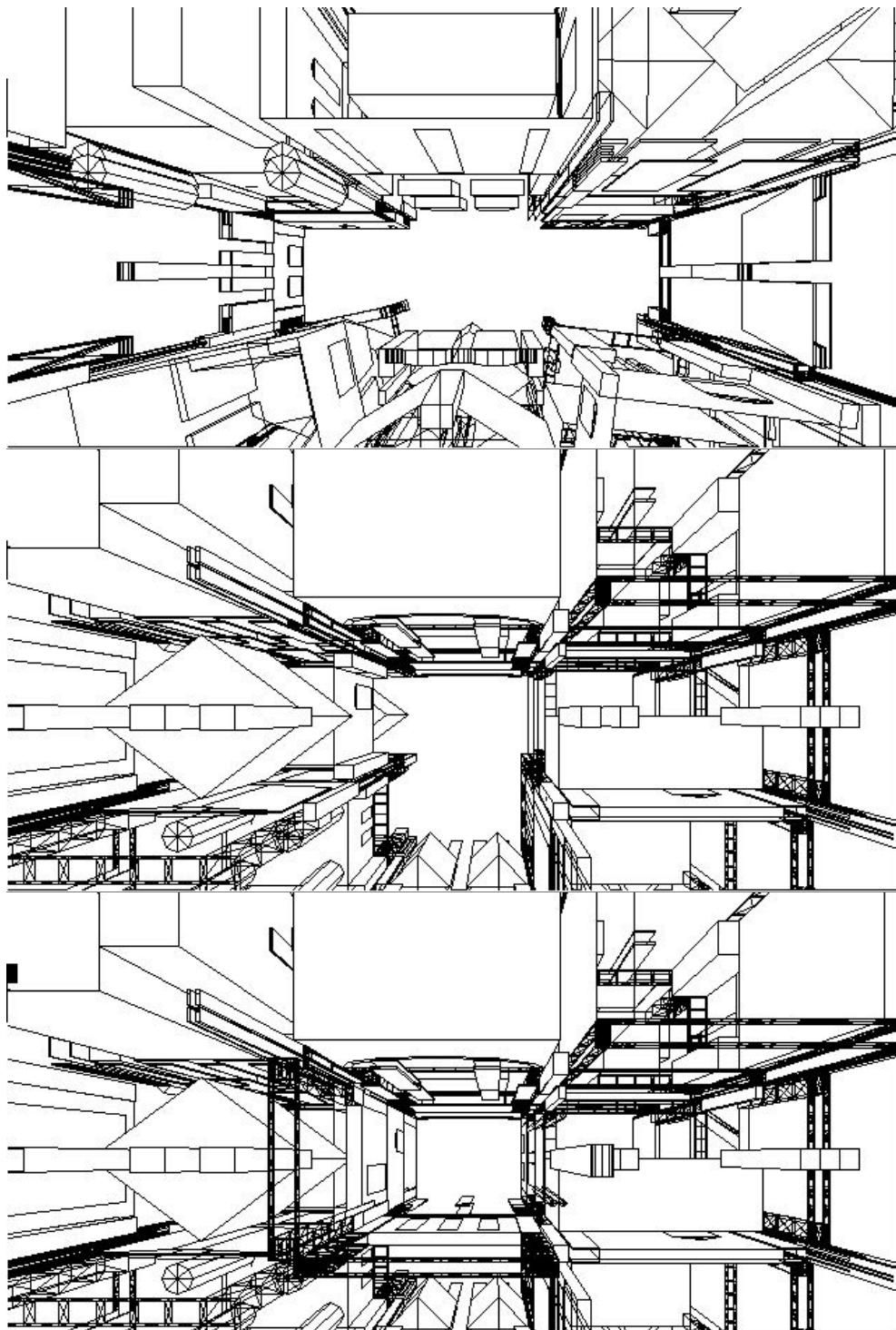


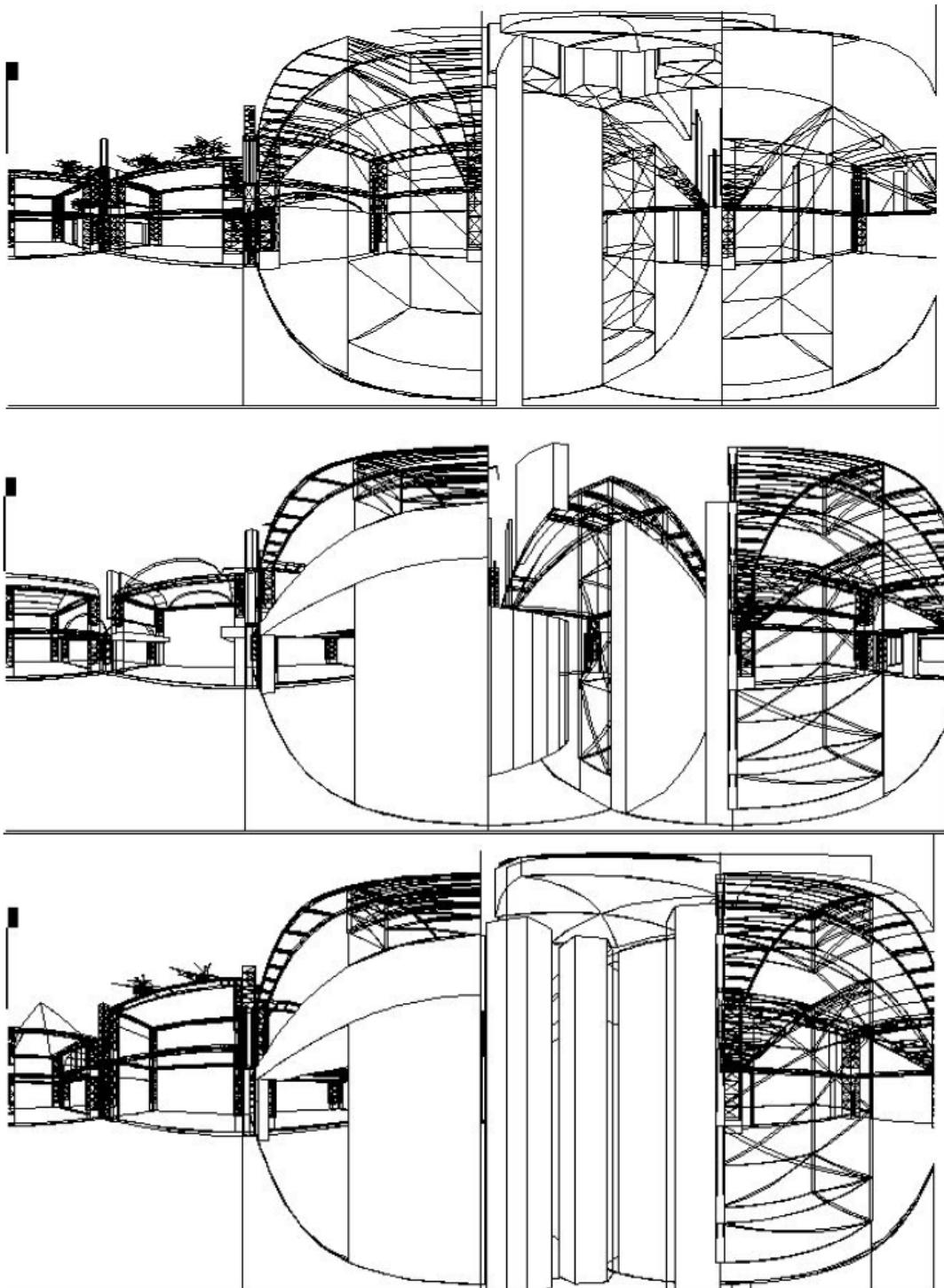
Nelle immagini precedenti Fig. 1-6: Un modello di architettura virtuale diverso dal precedente, ma appartenente alla stessa specie. La sequenza delle sezioni successive mostra la medesima logica evolutiva, una storia evolutiva differente ma parallela nella temporalità virtuale del processo progettuale simulato.

Fig. 1-8. Serie di modelli con vista zenitale. La logica evolutiva dei quattro scenari virtuali successivi a destra si differenzia per l'ampliamento dell'accettazione di "eccezioni" alla geometria di base.









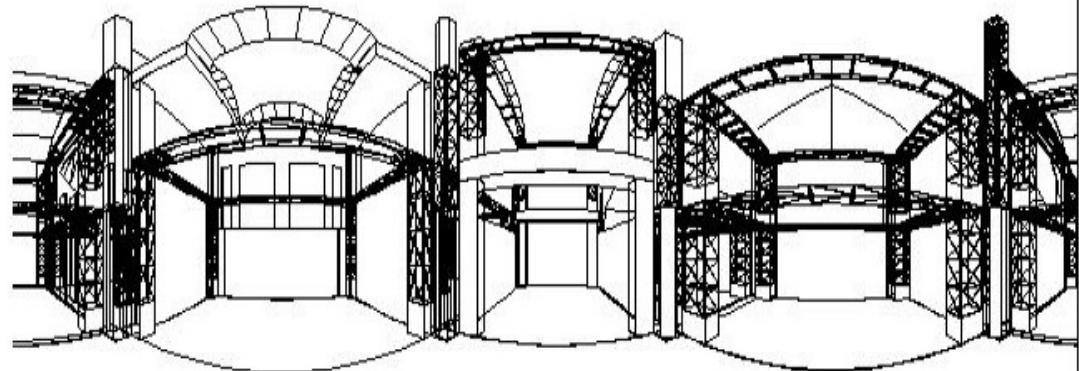
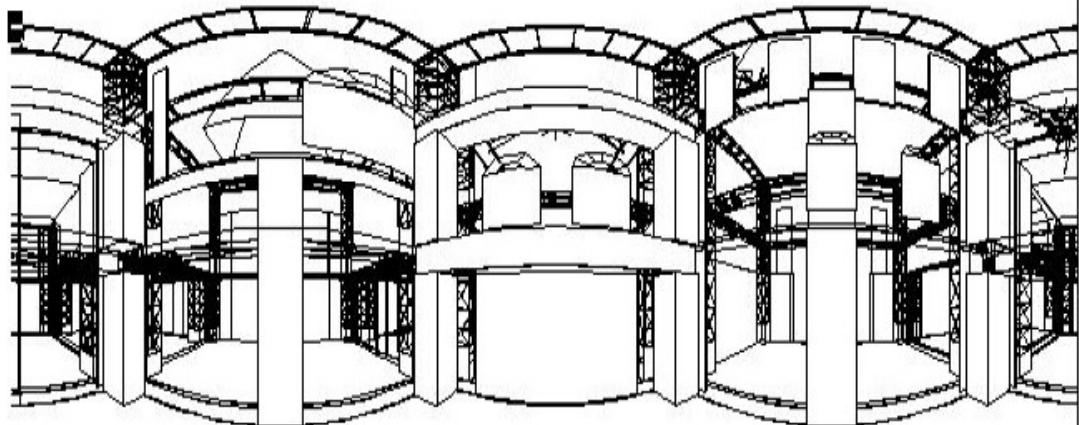
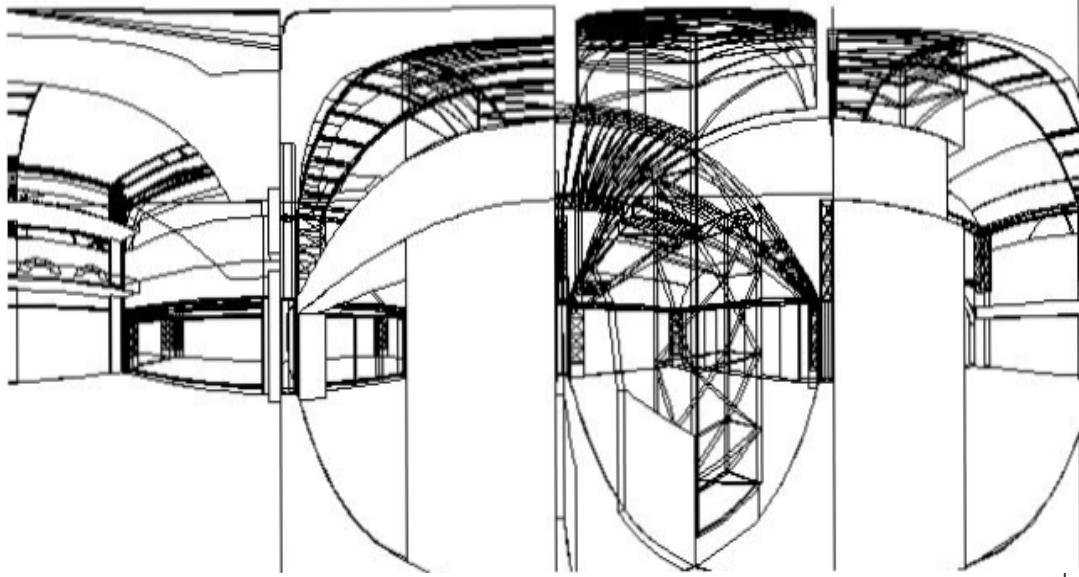
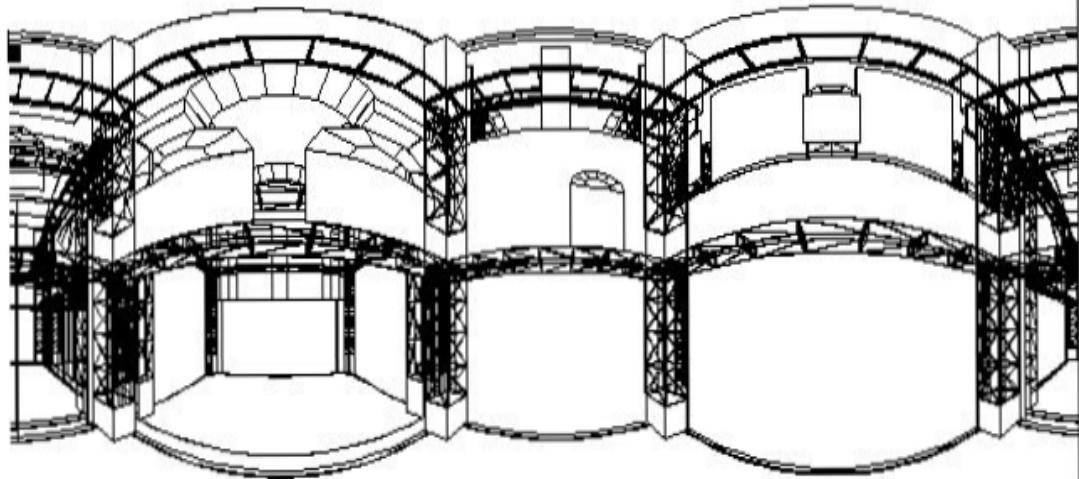
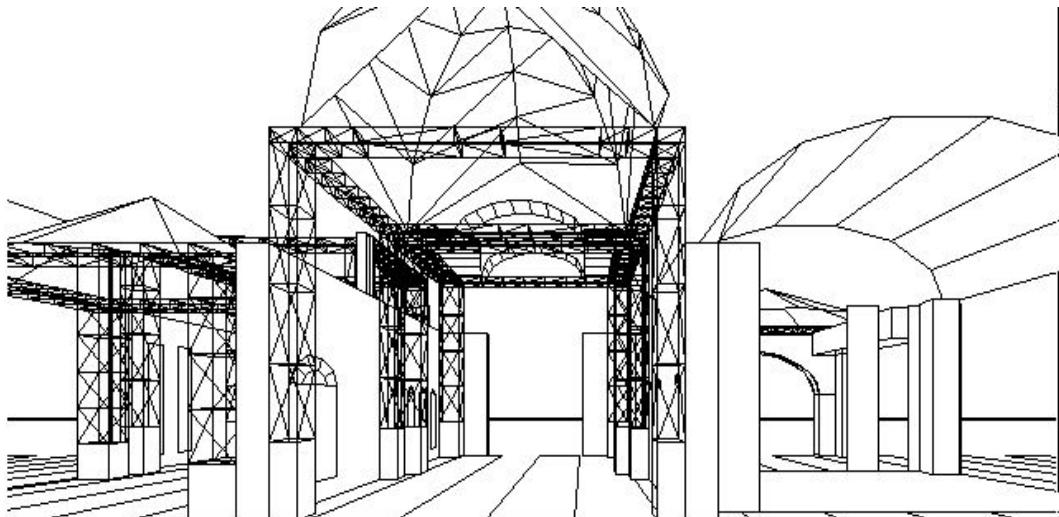


Fig. 1-3 on the previous page: and 1-2 on this and the next page. Other possible virtual architectures generated by the same project of species, but represented in a total 360-degree perspective, from an observation point inside the architectural space. These representations allow greater control of spatial sequences and interface generation logic.



## BASILICA PROJECT



These species projects have characteristics very close to the Terme project, in fact, they have the same imaginary world of reference, but they differ above all in the fact that they follow, from the first model to the last, a possible evolution of the species. It is, in fact, a possible virtual history, a subjective retracing of the morphogenetic dynamics that from a basilical structure of the architectural organism leads, through successive verifications and adjustments to architectures that are totally different from the initial ones, but that have, in fact, the same genetic structure.

The reference imaginary used is, obviously, the basilica. And above all, its structure is essentially a cross between two main sequences, one of which is hierarchically more important. Another subjective reading of the characters of these architectures has been to use the cover structure as a tool for characterizing spaces, and their sequences. Compared to the "historical" reference of the basilicas, the subjective approach used widens the possible interfaces between spaces, and especially between individual spatial events and the outside, introducing a complex range of relationships that often become spatial events.

The interest in some construction technologies and metallic materials, as well as some weaknesses towards structural complexity, denote the subjective approach and bring him closer to the Terme project.

But what, in this experimentation, is proposed to the analysis is the progressive flow of the image possible through a transformation in progress of the same compositional logic. Between the first generated models and the last, there is a difference in the generation, a historical difference.

And this does not reside in the formal matrices used, nor in the choices regarding symbolic functions or the structure of reciprocal relations between spaces, nor in the procedures for formalizing interfaces. The evolution, or in any case the progressive transformation of the species (and of the relative project) has been carried out

experimentally verifying, in the field, the possibility of inserting and using some procedures of overturning, of a logical jump, which then remain in the project as memory.

It was like taking a child by the hand through a thousand difficulties, training him or her to overcome the unpredictability and randomness of evolution while maintaining his or her own identity, or rather discovering that, in order to consolidate, the latter needs to grow and transform itself.

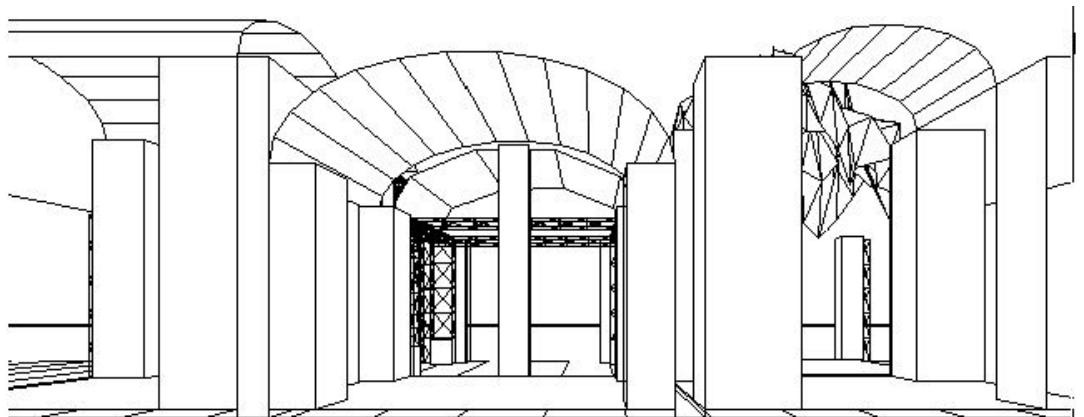
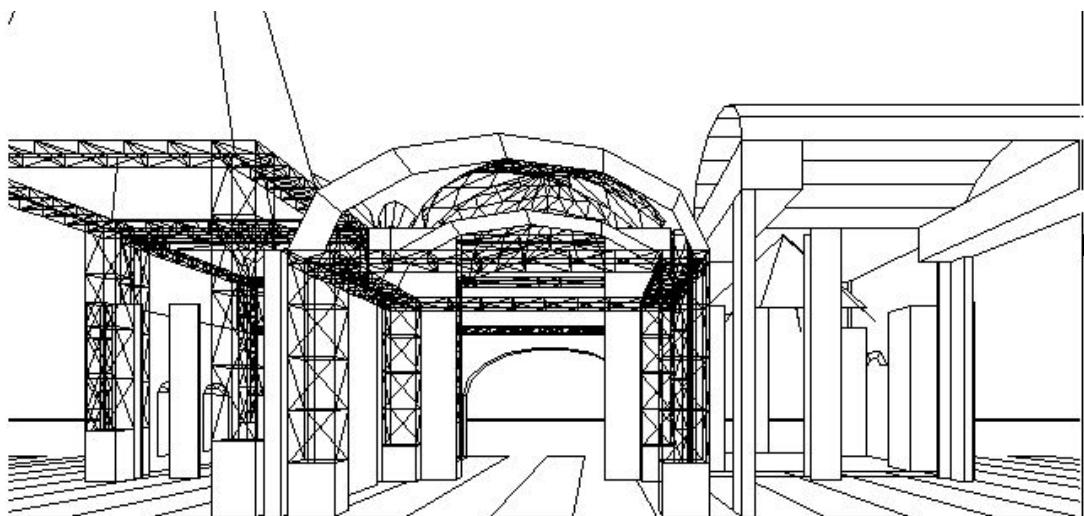
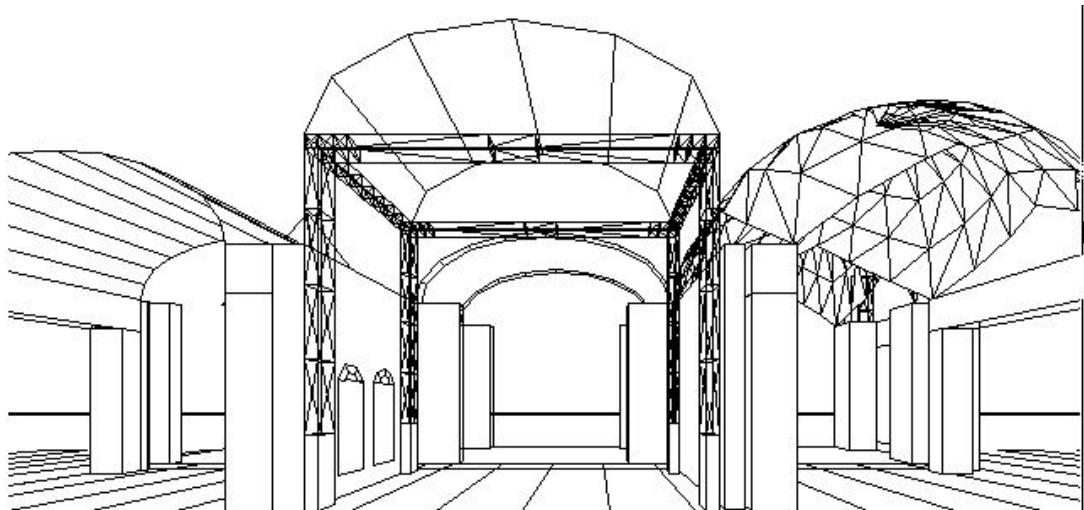
We have thus trained our project, and in order to verify the self-preservation reactions that structurally we had inserted, we have provoked a whole series of difficulties.

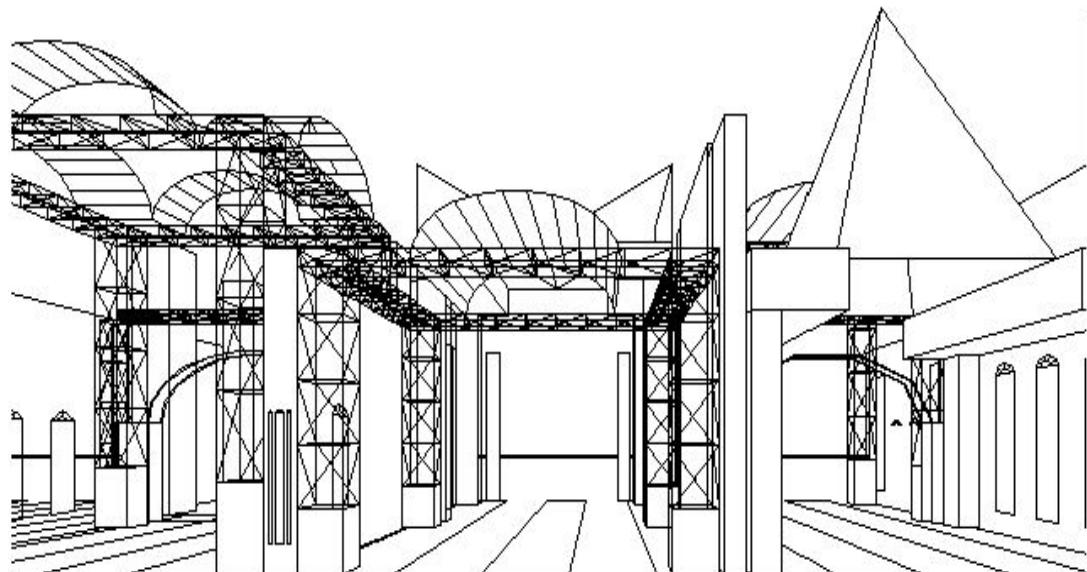
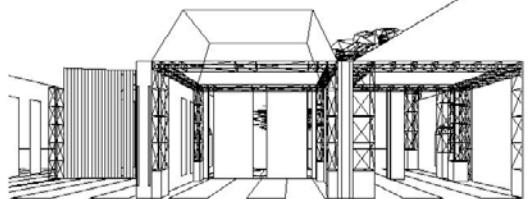
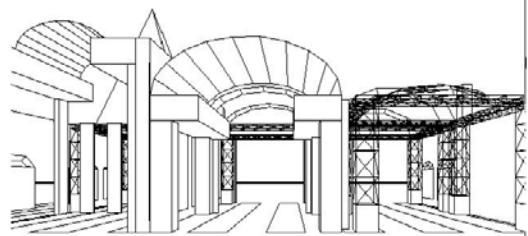
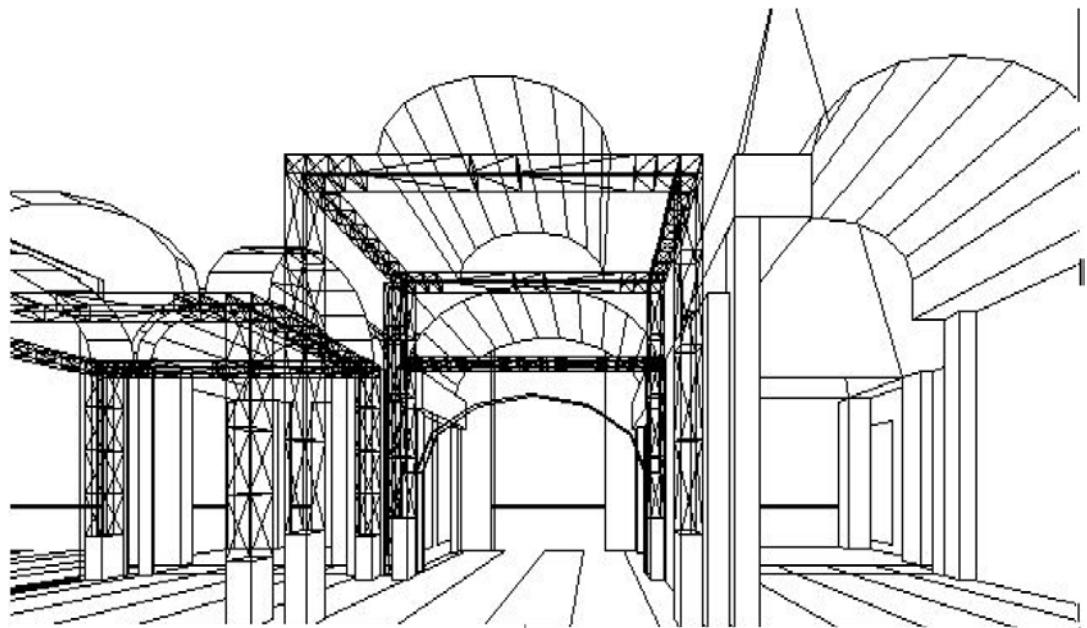
First of all, we experimented with the possible limits in the progressive acceptance of exceptional events, pushing the verification to the threshold limit before the upheaval of the plausible architectural structure. And by calibrating, in each verification, also the arbitrariness of setting the limit beyond which the event itself had to be considered exceptional.

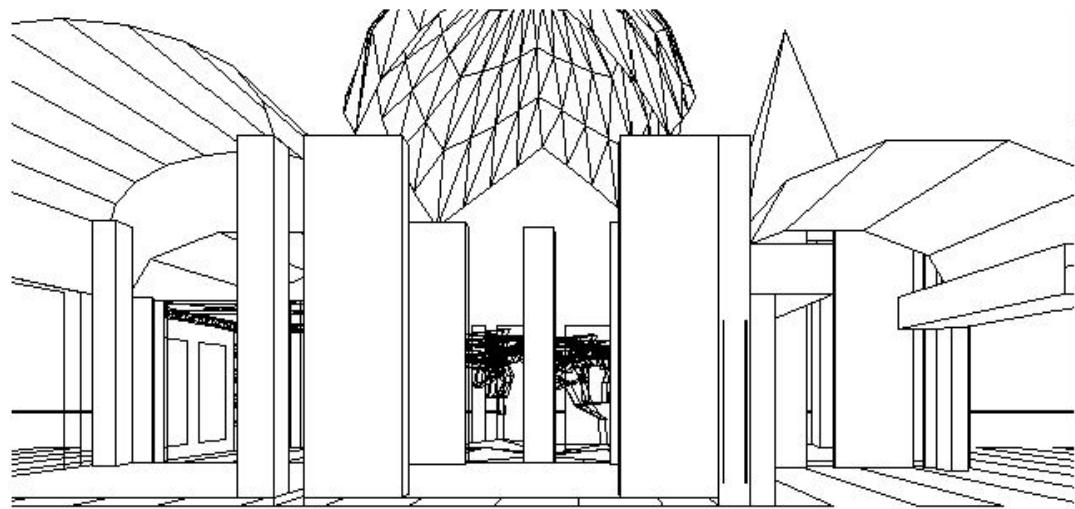
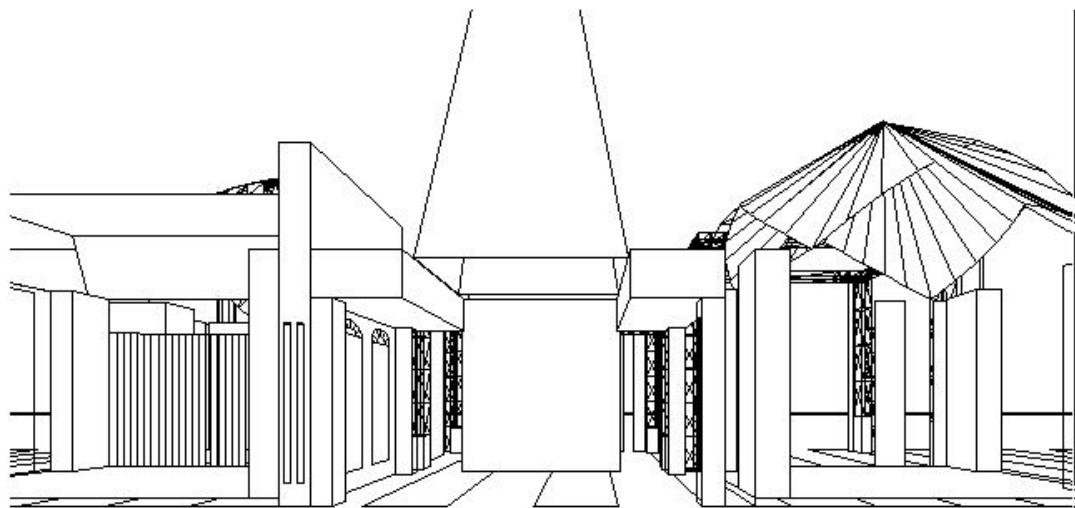
But what really made it possible to make a jump, to trigger a process that would allow you to work on the estrangement, and therefore on the growth of complexity of its world of reference, was to include the joke in the training: unpredictable and random reversals of assessments within the material that the morphogenesis project itself generated. One of the most interesting attempts, and that it is possible to evaluate in the last series of images, was that of exchange between what was considered, in the verification grid, a full and what was evaluated as empty. This while maintaining the same logical procedures.

The results were surprising, and the image reversal was decisive. The project born from the Basilica project was called Arca. The virtual architectures generated traced an unforeseen but recognizable architectural image, thus identifying some viable channels for the development of one's own logical approach to design.

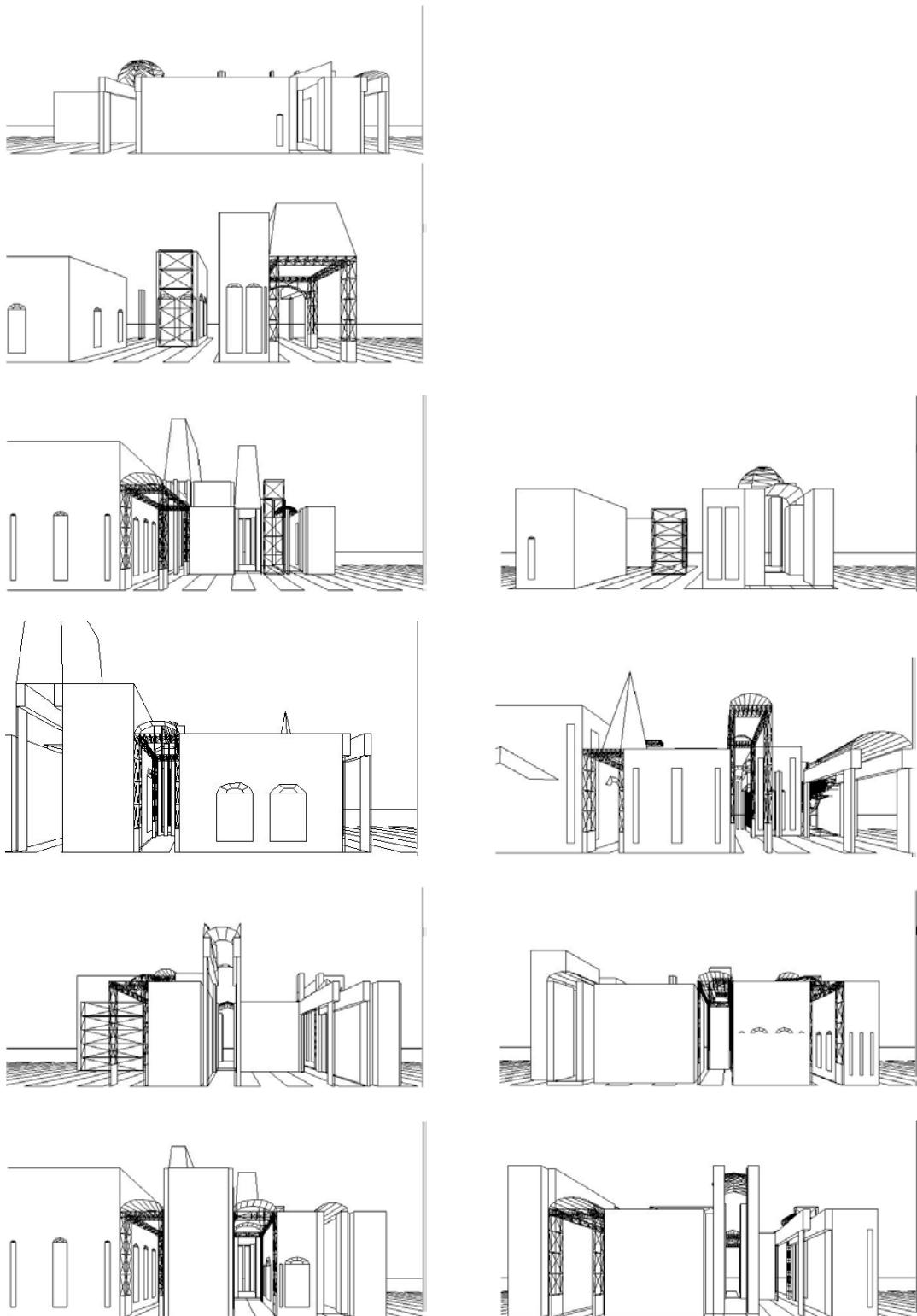
*In the images of this chapter the sequence of the progressive shift from the project of Specie Basilica to the project Arca. Starting from an extremely controlled logical paradigm, we have passed, through successive layers of meaning, increases in complexity and the development of a logic of acceptance of exceptions as the engine of possible reversals of the same procedures adopted, to the generation of virtual architectures whose recognizability, as a species, refers to a more complex contemporary imagery.*

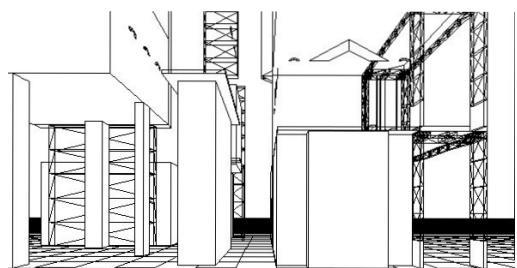
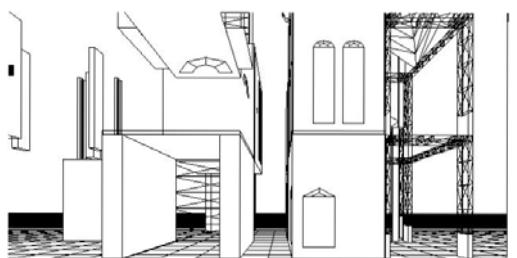
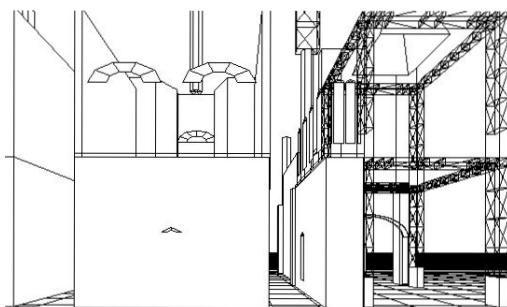
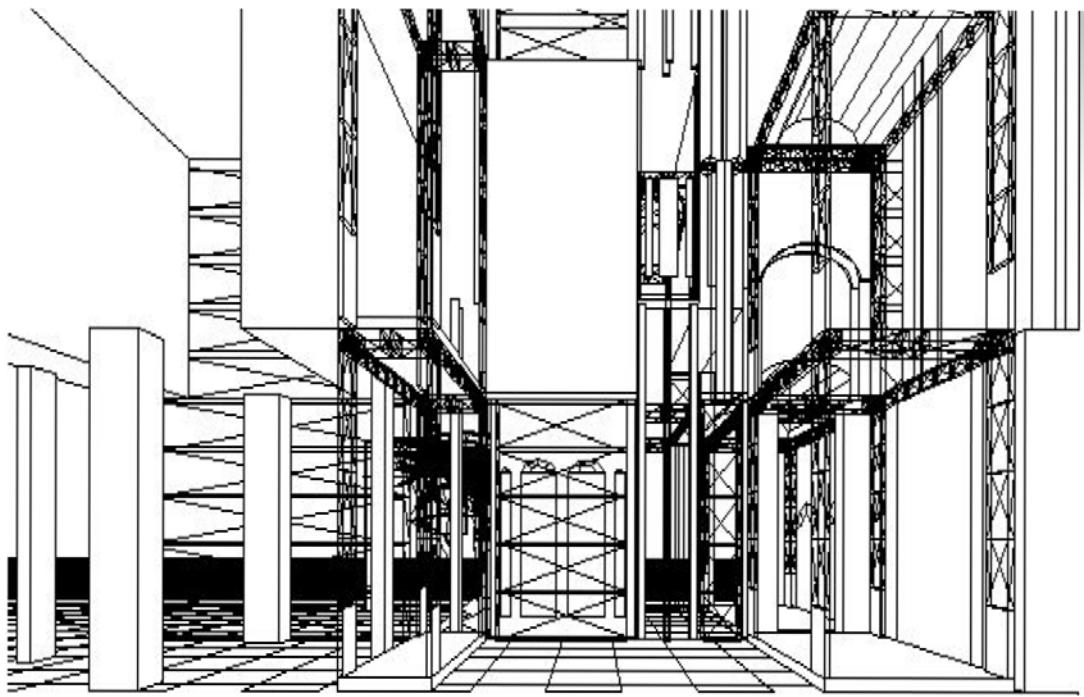


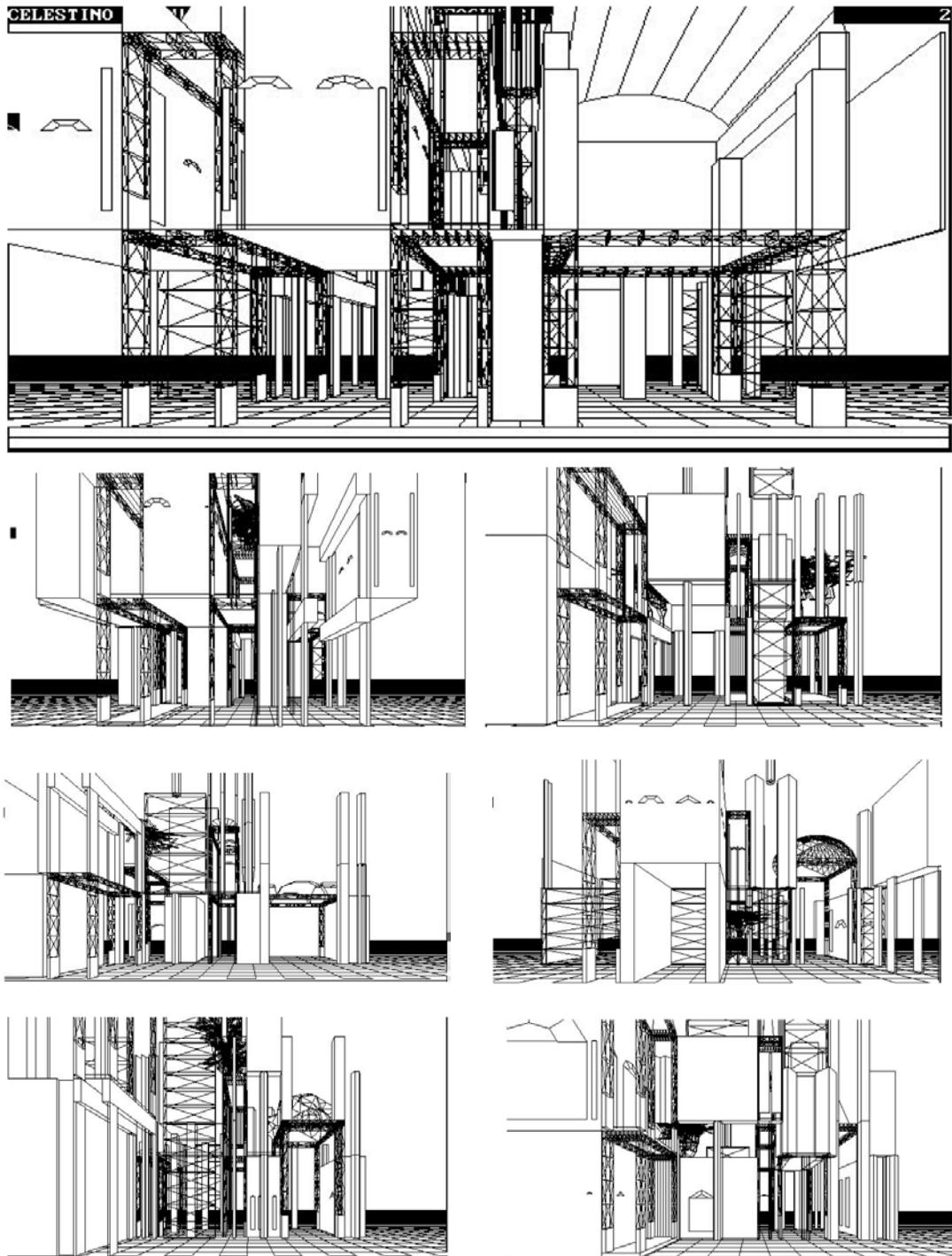




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Environmental Design of MORFOGENESIS. Genetic Codes of Artificial







## MORPHOGENESIS DESIGN FOR A CHAIR

Design of the DNA of an industrial object

*Our mood puts a price on everything that comes with the case.  
Francois de La Rochefoucault, "Massime"*

The project of species is a software that generates, in a continuous flow, an infinite series of virtual objects; in this case a series of chairs, one different from the other, but all recognizable in a compositional species. It is therefore configured as the design of a varied series of chairs that are not born from an abacus of pre-designed components but from having defined the Genetic Code of the Artificial, the mode of evolution of form.

Operationally this type of design makes possible a series production of chairs all different, but all recognizable by a common compositional matrix. The realization of the series of unique objects can take place through numerical control machines of which the morphogenesis project, as structured, can become the system of automatic reprogramming in real-time.

Therefore, with the current production techniques, it is possible to achieve the realization of a varied series of always different industrial objects, with the same machine cost of the realization of always the same objects. But this requires a different design: the design of morphogenesis.

The morphogenesis design presented in this chapter defines its objectives on the basis of a subjective imaginary reference. It includes, without exception, what of the idea of a chair has been subjectively remembered, evaluated and desired as responding to possible and conceptually important needs of human living.

This imaginary reference, which later becomes the measure that can be used to verify the quality of the project, has been built considering, above all, the aspects of the image, including those related to the use of specific materials and construction techniques. Other aspects such as the ergonomic one, for example, although very important in this type of objects, has not been developed as a hierarchically primary factor but only as a plausibility grid. This in consideration that the experimental aim of this project is to verify, preferably on the image level, the multiplicity of possible different developments of a genetic code structured in compositional logic.

It must be remembered, at this point, that this subjective imaginary reference is not in balance, but simultaneously pursues an evolution, a growth of complexity, through the very realization of the species project. The multiplicity of scenarios produced during the design elaboration of the genetic code, in their multi-laterality and unpredictability, have significantly contributed to the expansion of the same reference imaginary. This through the explanation of the image potentialities that single subjective ideas can express by living possible virtual stories of formal, technological, constructive and material evolution; and therefore simulating in parallel possible increases in complexity, possible shifts from categorical/subjective to plausible/inter-subjective.

The variables that are considered and evaluated during the design of the formal genetic code are essentially two: the formal matrices and the procedures.

In particular, the formal matrices define the individual, the contingent chair object,

and the procedures define the designed compositional species. In this sense, the formal matrices can be considered interchangeable, at least until their acceptance in an individual, while the procedures guarantee, with their uniqueness, the presence of the characterization and recognizability of the species.

But formal matrices are not the basic forms that are used compositionally. The latter is only the results of a set of basic procedures, of generation devices.

Each form used is unpredictably born from the resonance of linear dynamic procedures that operate on some formal specifications, dimensional structure, geometric matrices, technological and material matrices, and complexity as an appreciable amount of information. The unpredictability, as non-linearity of evolutionary dynamics, arises from this contamination/resonance of several simultaneous linear systems.

The ability to generate order is evaluated for each accepted form, and parameters are set for the subsequent structuring of sequences between formal events and the generability of interfaces.

While the forms can always be different, and their substitutability and interchangeability within the system are foreseen as not influential on the compositional character, the procedures are the compositional character, they identify how the subjective approach to the project is expressed, they characterize the compositional choices of the designer.

Therefore the procedures are of two types: those of form generation, i.e. the events proper to this design occasion (seat, backrest, floor support, and so on, including possible cross-contaminations and interfaces), which operate by formalizing events whose unpredictability is given by the concomitance of several linear evolutionary systems; and those that implement the design itself, which is activated using the forms generated and accepted as further requests for formalization.

In reality, the cycles requested/formalization/further request are more numerous [2], and their very structure (the transformation of a request into a more sophisticated request, through formalization processes) defines the evolutionary dynamics of the form proper to the design approach adopted, and guarantees the uniqueness of each individual virtual object, while recognizable, characterizing and quality of the species.

This because every generated object, even if unpredictable and unique, has a predictable level of quality, as it depends not on the single shapes used, but on how they have been generated and how they have evolved, from the first strongly subjective input, towards complexity.

But the quality also depends on how long and tortuous their virtual history has been. That is to say, two factors, which remain quantitatively comparable in individuals: the number of cycles required/form/further-request that have followed, and the accepted exceptions that have simultaneously allowed growth in information capacity and access to complexity. In fact, let us remember [3] that the complexity of a system derives directly from the length of the lived history and from having gone through different regimes. And the role of the exception is to make it necessary to make an adjustment, and very often also a logical leap, from the previous to the next circumstantial paradigm with respect to which the project will develop.

In this morphogenesis project, particular attention has been paid to materials and construction techniques, experimentally transcribing in formal logic some specific characteristics of the related disciplines. For example, metal gratings, even those that follow curved geometries, are not generated through procedures that ignore their constructability, but the same potential and specific vocations have been translated into formal logic. Therefore, the image and its technical feasibility have been brought back to a single language, to the same control system.

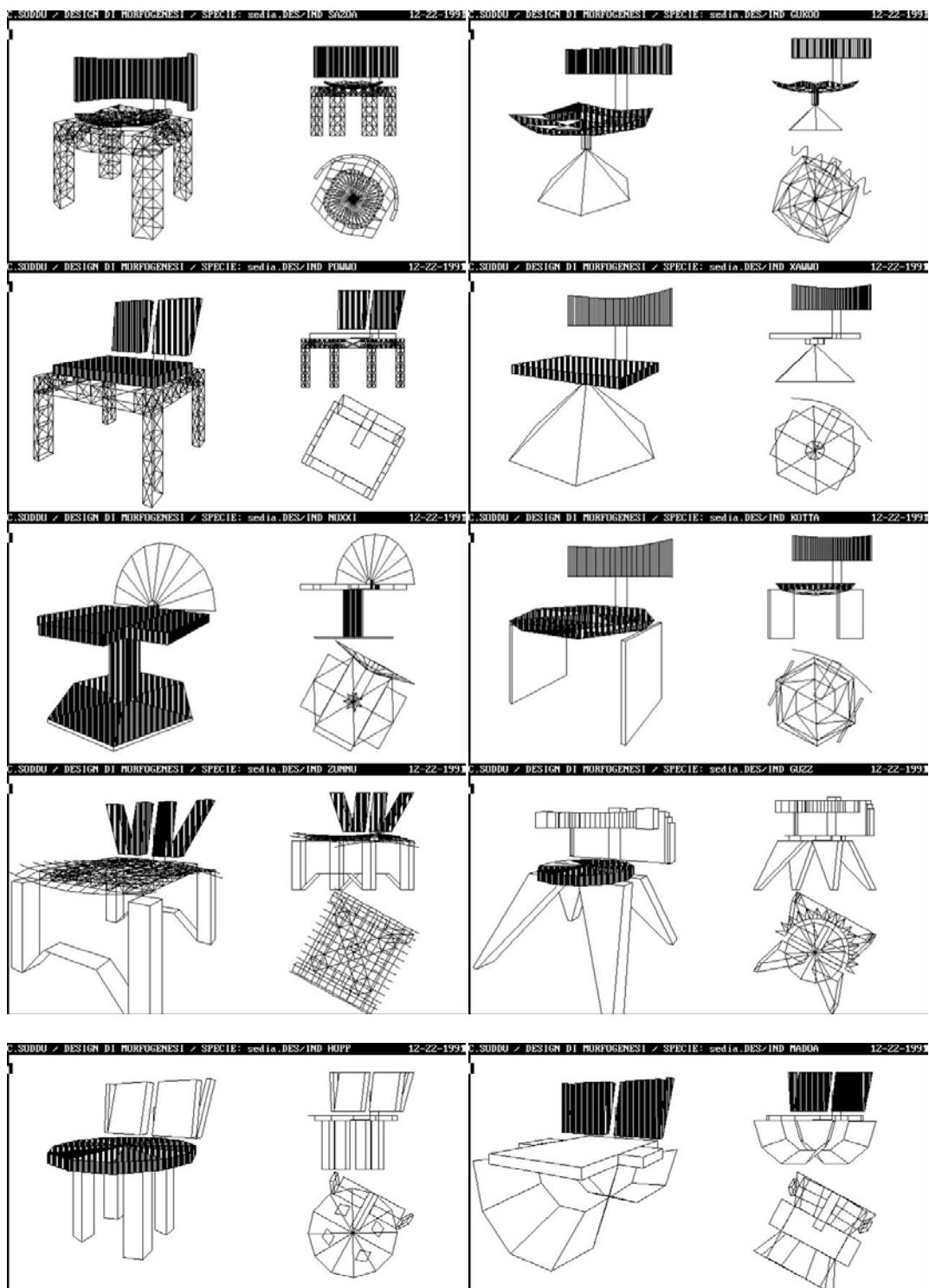
The following images are just some of the virtual objects generated by the Chair morphogenesis project. Each image is a computerized three-dimensional model and is defined up to the indications of the materials. Each model is different from all the previous ones and can never be repeated identically, because, if this would happen, the system would change its own mathematical character transforming itself from chaotic dynamic with unpredictable development, to cyclic dynamic with the temporalized and predictable repetition of the same events.

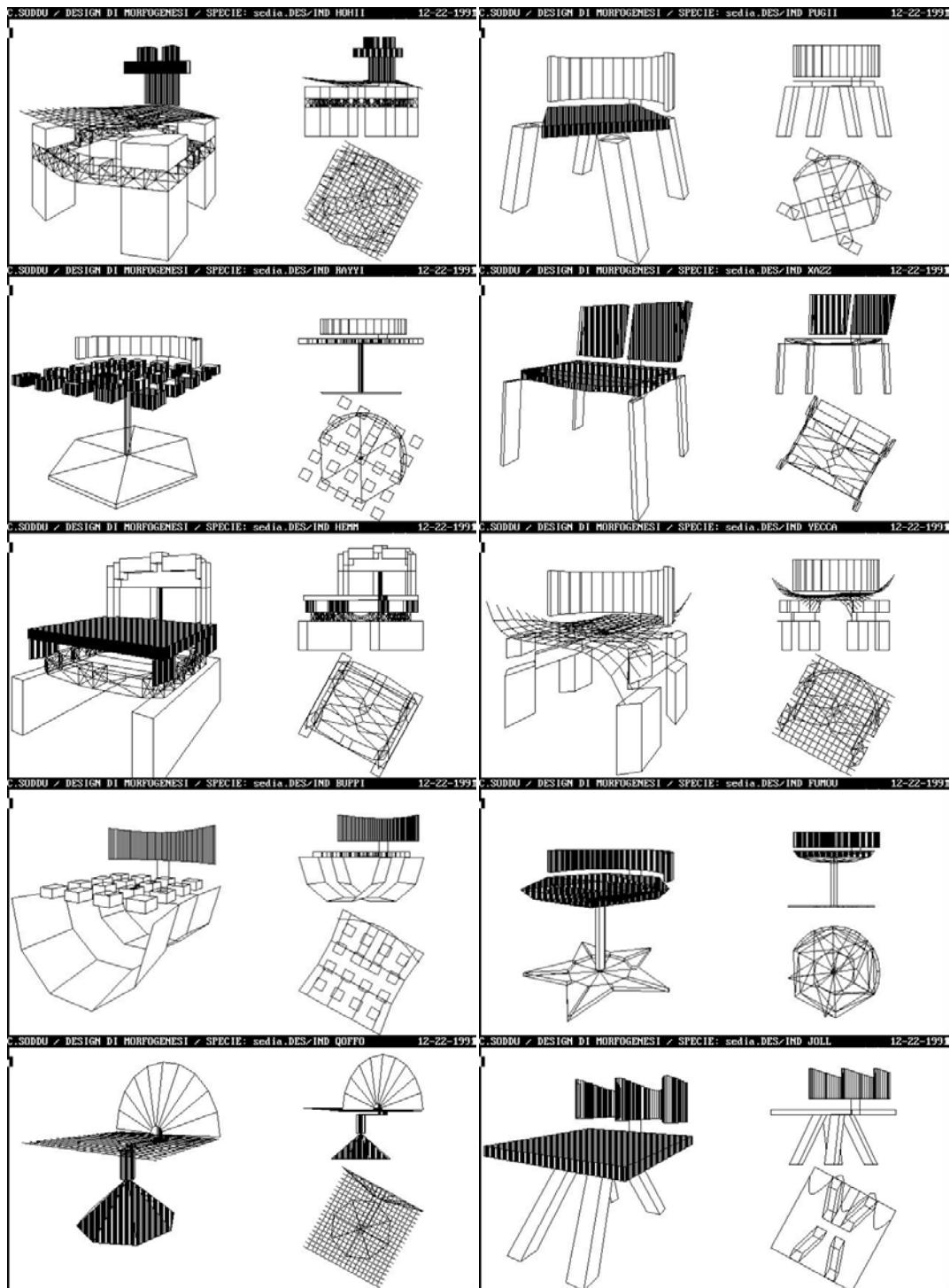
*Note 1. I. Prigogine, op.cit.*

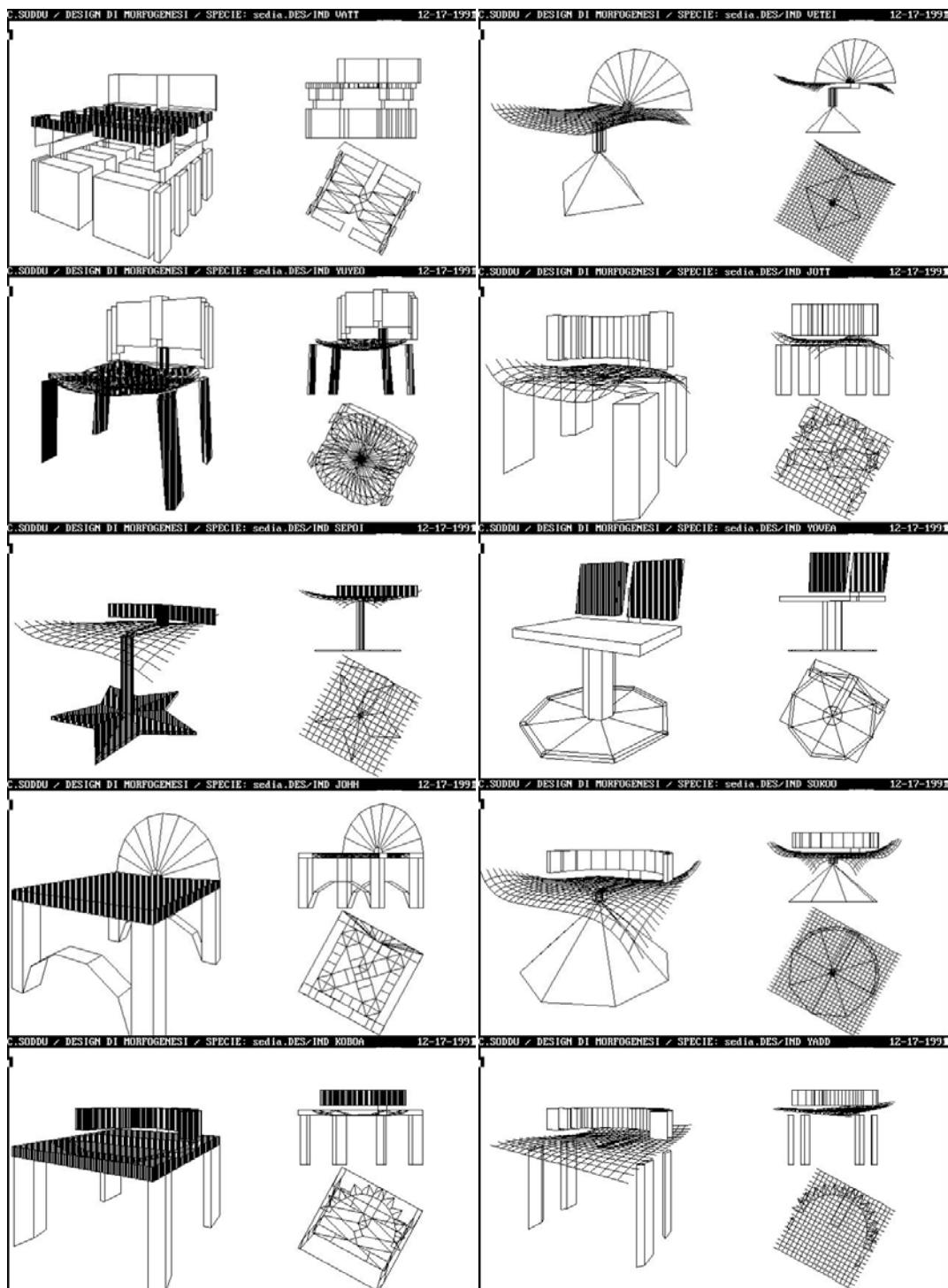
*Note 2. Several different cycles are activated through the same devices in generating the shapes, and then several cycles for the formalization of the whole. Each cycle, operating on the previous formalization, increases the complexity of the final form and foresees also the possibility to generate exceptional events (out of what is normally acceptable) that interact directly with the structure itself of the adopted compositional logic, operating an adjustment, and increase of complexity', of the activated Indian paradigm.*

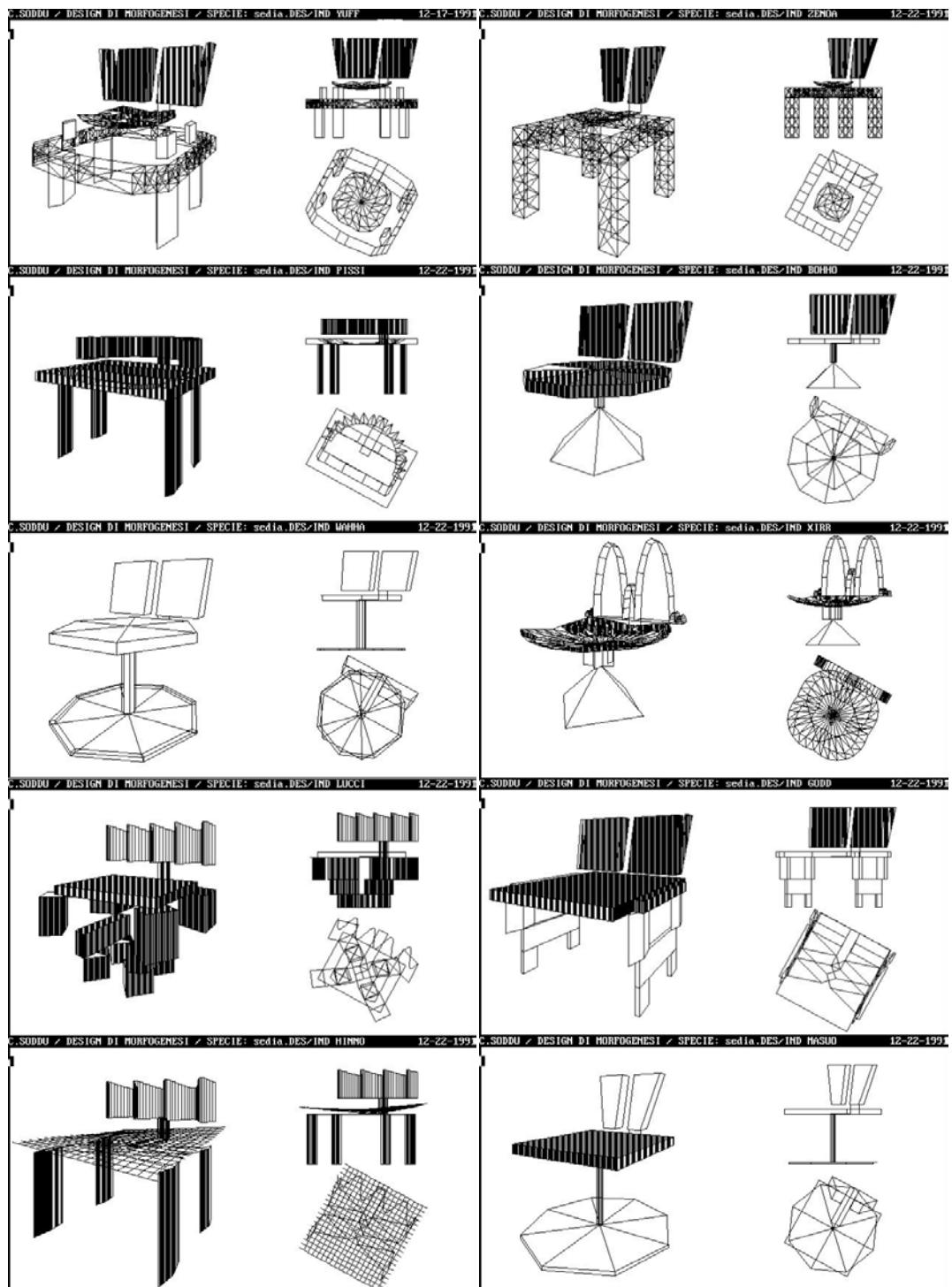
*Note 3. Prigogine, op.cit.*

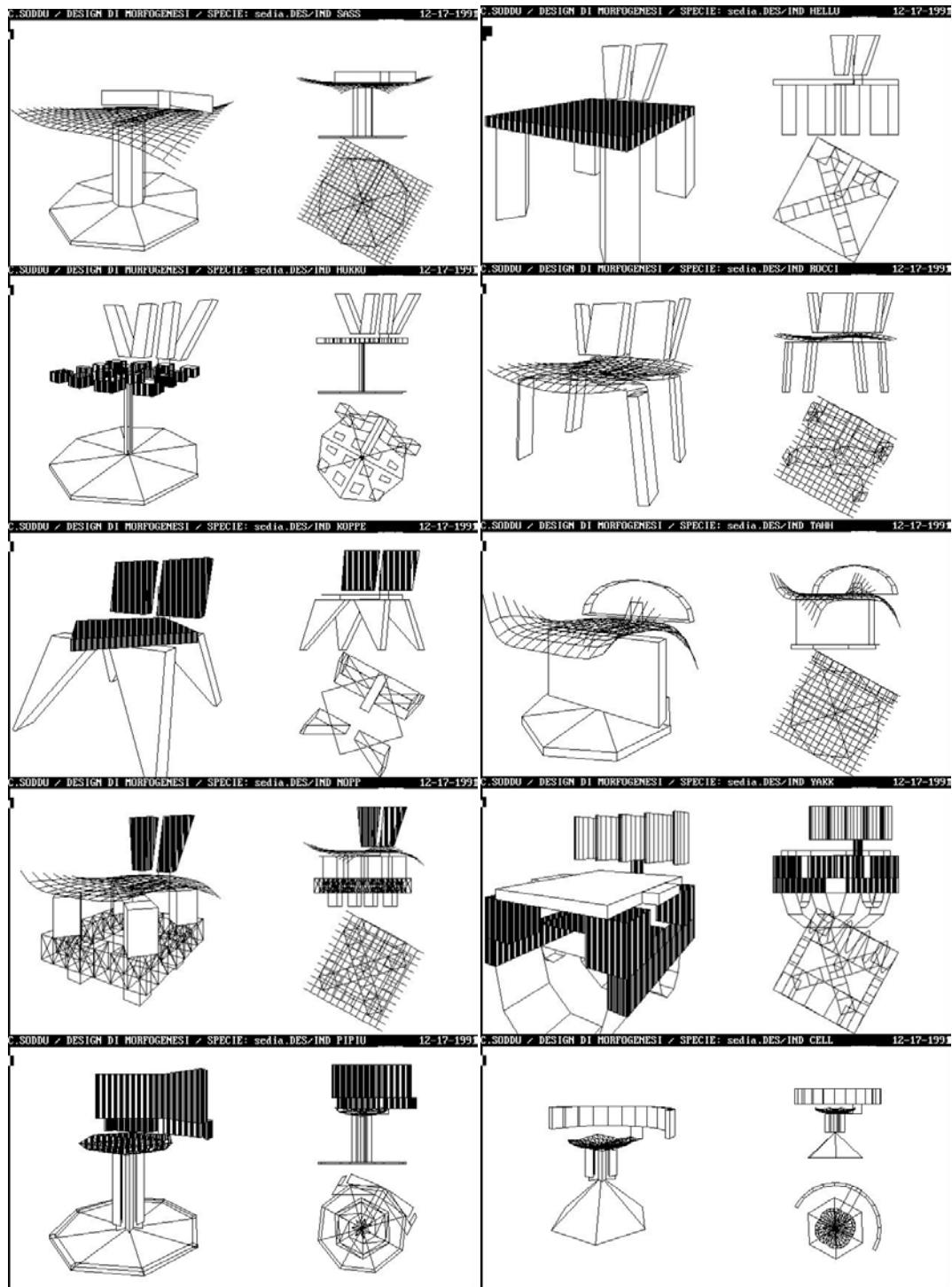
*On the following pages: Images of the morphogenesis project of a Chairs Species.*

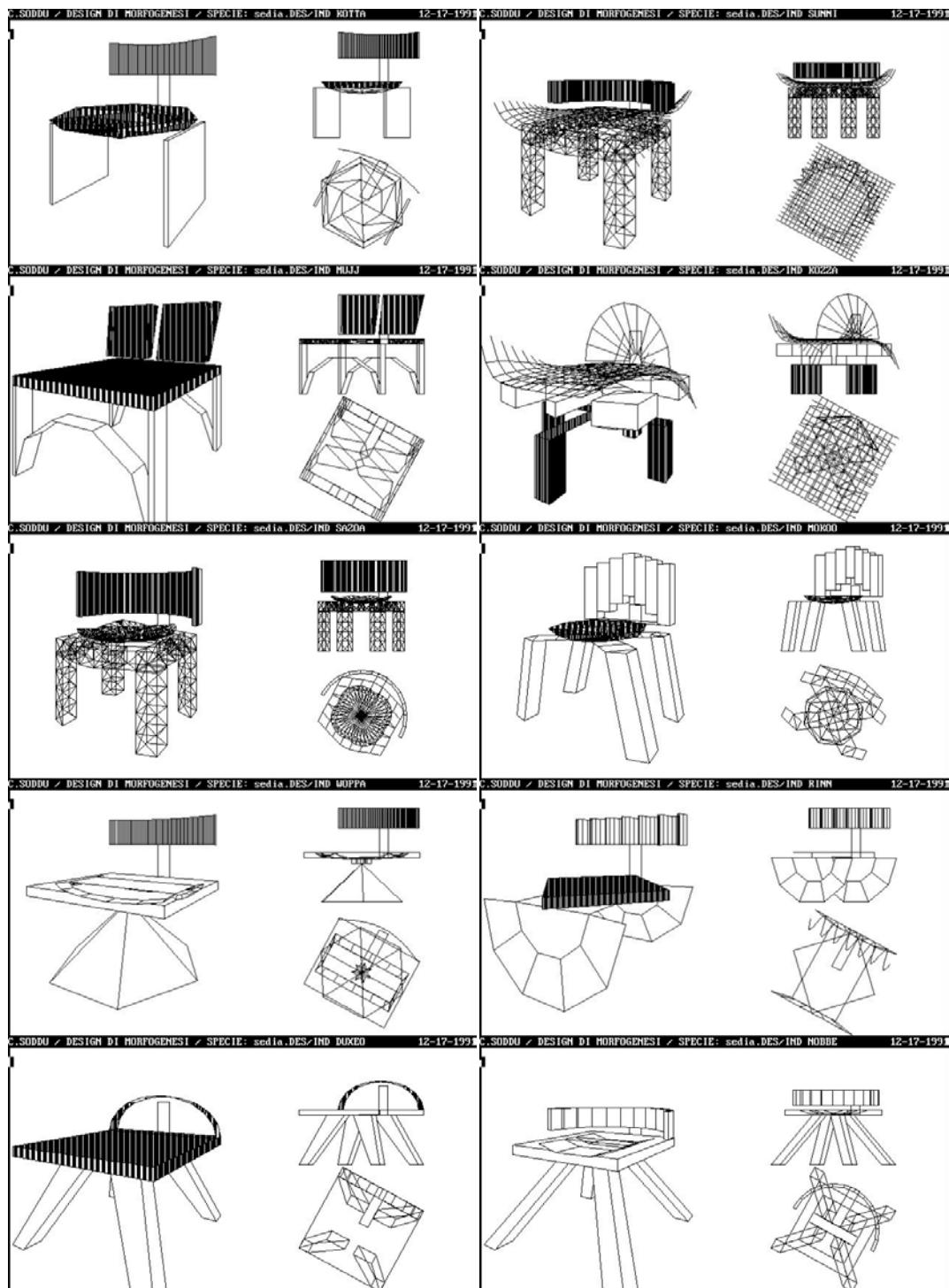












## THE DRAWING

Rappresentazione e Controllo della Forma e delle sue Trasformazioni



*"The vertical lace of the Venetian facades is the most beautiful design that the weather-alias-water has left on the mainland, anywhere on the globe. Moreover, there is undoubtedly a correspondence - if not an explicit link - between the rectangular nature of the forms of that lace - i.e. Venetian buildings - and the anarchy of water, which disdains the notion of form. It is as if space, aware - here more than anywhere else - of its inferiority over time, responded to it with the only property that time does not possess: with beauty".  
Iosif Brodskij, "Foundations of the incurables"...*

## **PREMISE**

Drawing, in the fields of environmental, architectural and design planning, must respond to the need to communicate and reflect on the world. And the world is everything that happens, it is the totality of facts, not things [1].

To graphic note by drawing a formal idea is, without doubt, to recognize and interpret the three-dimensional formal matrix of a thought event, virtual or real, but it is above all to read its evolutionary dynamics as a further dimension. In this way, drawing becomes an indispensable tool for reflection in the work of acquiring the characters, quality and identity of the evolving environment, and above all it becomes a design tool, allowing us to arrive at compositional results more pertinent to the idea being pursued, and with a greater charge of complexity and, therefore, quality. If we then translate into algorithmic language the compositional idea of the event itself we have amplification of this dimension and potentiality of the design.

A good project drawing, therefore, does not come from manual skill. It is the result of the ability to mentally control even extremely complex spatial entities both in their particular three-dimensional arrangement and in their possible morphogenetic dynamics.

And this is an ability that is acquired through experience.

To deal with drawing today is also to know, and use as a second pencil, the advanced systems of representation made possible by current techniques, and to be aware of current trends and development possibilities. A sector, this one, which, starting from the use of computerized programs to help drawing, and therefore of techniques to support conventional representations, is moving towards further tools, envisaging a widening of the field itself of the representable.

The use of advanced control, representation and simulation systems and models (such as fractal geometry or the simulation of dynamic systems of a random type applied to the design of the artificial) is not, in fact, in the function of making quickest of conventional representations as a non-computerized representation is practically not possible. These representations are the most suitable tools to operate experimentally on the transformation of the environment and to activate the necessary controls on its evolutionary dynamics. They also provide a valuable and indispensable tool for the analysis and communication of an idea of space and its transformation, which makes the work of the designer in tune with the current development of scientific research, which tends to operate more and more directly on how it evolves.

Note 1. L. Wittgenstein, "Tractatus", op.cit.

## TRACE AND THOUGHT

Historically, drawing has always been a moment of knowledge and reflection, but above all a moment of synthetic intuition of events, and of the possible underlying relationships.

Drawing is commonly used as a tool for the representation and communication of an existing idea or event. But the representative aspect is only one of the potential of drawing. The most surprising aspect is expressed in the work of discovery when representations are made, models are made in order to reflect on the possible.

It is here that the potential of drawing is exploited in the simultaneous approach to the different facets, to the different codes of reading, analysis, and control that are possible within a complex event.

If we retrace the history of human knowledge, drawing has always had a privileged relationship with scientific discovery because, through representation, the intuitive process is made explicit and formalized. In particular, there has always existed a preferential channel, almost a coincidence of intentions, between drawing and mathematical intuition.

In the last century, this instrumental specularity has faded considerably, also in relation to the fact that theoretical-formal intuition exceeded the possibilities provided by the available graphic instrument, the pencil, whose potential within a process of the discovery appeared, at least, to be exhausted.

In reality, this is not entirely true. On the contrary, for some centuries it was exactly the opposite. In some sectors, there has not historically been an exhaustive mathematical-scientific answer, which would have been at the height of the intuitions operated through the tracing of forms.

The approach through drawing, and in general the pre-vision due to this tool of simulation of the possible has always directed the scientific systematization, often preceding it by a lot. An enlightening example is the history of the perspective itself.

Perspective drawing is a fundamental mathematical intuition, whose scientific value determined the Copernican turning point in modern science.<sup>1</sup> But that is not all. The essential contribution of perspectival intuition in the field of physics began to emerge only ten to fifteen years ago, in light of today's instrumental potential to analyze the characters and peculiarities of the iteration of equations.

There were essentially two fundamental insights into perspective design. First, the possibility of controlling an infinite system in a finite formal model. And this proposed the subjective reading (as is the perspective one) as a reading capable of embracing, simultaneously, the infinite in a finite and controllable model. But what we surprisingly find as a proposal of perspective drawing, and which we rediscover as a structuring approach to current mathematical and physical progress, is the concept of invariance of scale.

These two aspects are the leitmotif of the critical and operative cut that is proposed here, and that recalibrates in the light of scientific actuality the possible approach to drawing as a moment of intuition.

### 1. The infinite.

The perspective image stretches infinity within a sheet, and when we draw a

vanishing point we (as Gioseffi observes) draw the first point beyond infinity. But this is often not sufficient for a designer's need for total control of space. The represented infinity, though infinite, is always a portion of the total infinity that we live and try to control from a design point of view. It is only the space corresponding to the optical cone.

Hence the research we have carried out on other perspectives approaches [2], a verification of curved perspectives that in any case do not address the problem at its root (curved perspectives are, in the end, nothing more than mathematical anamorphosis of classical perspectives), until the realization of the total perspective that represents "all" infinity from a point of observation that must be, given the assumptions of totality, necessarily internal to the represented space.

The design in total perspective, born from this research, has thus become, in our experiments, one of the most effective tools of intuition and control of space. It is quite insignificant if a total perspective, given its complexity, cannot practically be drawn with a pencil, but requires the use of a computer. After all, it is in the nature of drawing a close relationship with mathematical logic.

## 2. Invariance of scale. [3]

Extremely interesting above all because it is full of possibilities still partly unexplored is the concept, inherent in the perspective design, of the invariance of scale.

By invariance of the scale we mean the fact that a perspective representation has such a structure that it can systematically reproduce at successive enlargements of scale (at successive zooms) an image that is comparable and sometimes even identical to the total image.

Imagine, for example, the perspective of an infinitely long square tube seen from the inside. Graphically, the drawing consists of four lines converging at one point. If we operate successive enlargements of the image, while theoretically, it is as if we were proceeding along the tube, practically the image does not change since the enlargement/approach produces drawings identical to the original.

If we operate on a more complex object, the drawing varies, but the recurring formal characters of the represented object will always be recognizable. Let's imagine, for example, the successive perspectives seen by the driver of a running train: everything changes but the landscape maintains its recognizability as a species. The form slowly transmuted through morphogenetic sequences making explicit and characterizing, in this transformation, the structure of the formal code that identifies it; this at least until a moment of discontinuity, a catastrophe, a threshold of traumatic variation of the type of landscape.

The perspective, therefore, as a representation of time, of the identity of a virtual evolutionary dynamic.

This invariance of scale, from the structure of progressive slippages to the traumatic event, is in fact found, with the same mathematical characteristics, in the most complex dynamic systems of unpredictable evolution existing in the physical world. The same has been the object of experimentation and simulation in recent years. And that has allowed proceeding in the knowledge and control of thermodynamic processes, in meteorology, and in the discovery of fractal geometry itself.

A fractal form, for example, which today is considered a reliable representation of natural forms, is conceptually a perspective representation. This form, in fact, arises from the subsequent iteration of the same procedure, the result of which is systematically re-proposed as input data. The specific character of a fractal form is given by the fact that, however it is enlarged, it has the same formal recognizability. If, for example, a fractal shape is characterized by an intricate play of spirals, similar to the shape of a cauliflower, when we enlarge the tip of one of these spirals we discover a

further jungle of cauliflowers, and so on.

This invariance of scale has the same characteristics as the perspective design. And we find it, surprisingly, in the most complex physical systems, those which, having a non-linear and unpredictable evolutionary dynamics, have been taken into consideration only a few years ago in light of the possibilities of operating through automatic calculation. The turbulence in the motion of fluids, for example, was liquidated, until a short time ago, as chaotic [4.] Now it has been verified that the passage from a linear motion to a turbulent motion occurs by successive doubling of the vortical motions, and the succession of these doublings is regulated by a ratio [5] that reflects and coincides mathematically with the succession, for example, of a series of columns placed at the same distance and represented prospectively with respect to a particular point of observation.

Drawing the evolutionary dynamics is, therefore, a new perspective drawing, even if the drawing is done by algorithms and the object of the representation is stretched in the temporal becoming. The research presented in this book, and which develops the possibility of representing cities in evolution, the possibility of representing species of objects and not only individual objects, re-proposes, today, the historical approach to drawing, rediscovering it as a moment of intuition in the knowledge of the physical world. And it is certainly an approach that denies drawing as a discipline confined to the representation of the already thought to rediscover the pleasure of tracing one's own thought in real time, formalizing one's intuitions and reflections.

If this does not take anything away from the pencil, it opens new perspectives to the discipline itself, not so much in terms of instrumentation but as an extension of the very field of drawing. If with the pencil we can draw an event, with the computer it is possible to draw an evolution and to work within this drawing for successive intuitions until the desired result. Just as we operate, for successive strokes, with the pencil.

What characterizes drawing is therefore not the tool, pencil or computer that it is, but the mental attitude. Drawing is, above all, dealing with complexity simultaneously, not analytically, following an intuitive approach. It is, therefore, above all, a way of thinking and not only, a communication of the already thought.

*Note 1. Decio Gioseffi in "Filippo Brunelleschi and the Copernican turning point: The geometric formalization of perspective. The beginnings of modern science"*

*Note 2. Celestino Soddu, "L'Immagine non Euclidea", The non-Euclidean image, Gangemi 1987*

*Note 3. Geometrically it can be described as a form of symmetry/homothetia.*

*Note 4. J. P. Crutchfield, J. D. Farmer, N. H. Packard, R. S. Shaw, "Chaos", Science n.222, 1987*

*"...until recently, there was no reason to doubt that rigorous predictability could in principle be achieved. It was felt that it was sufficient to collect and process sufficient information. This view was changed by a surprising discovery. Simple deterministic systems, even those made up of a few elements, can display random behavior. This randomness is of an essential nature and does not disappear if further information is collected. This kind of randomness has been given the name of chaos. An apparent paradox is that chaos is deterministic, i.e. it is generated by fixed rules which, in themselves, do not contain any random element".*

*Note 5. Feigenbaum's constant, 4.669201, represents the ratio of transition to chaos in every possible mathematical model of a chaotic system.*

## THE GRAPHIC SKETCHES

The first trace of one's spatial thought is, very often, a graphic note, a doodle. Whether it is born from an interest in remembering, and possibly communicating to others, an architectural emotion lived in reality, or it is born from a project idea and is mainly used for a personal reflection. But, in both cases, the substance does not change. The constant element that unites and characterizes a sketch is the tendentious reading that supports it at the base, and that has, in fact, generated it.

Tendentious and, intentionally, ambiguous. But this is not negative with respect to the purpose. On the contrary, it becomes an indispensable factor when the use of the graphic note is that of reflection, both on the real and on the imagined.

Let's see why. First of all, the graphic note is a two-dimensional image. But it alludes to the three dimensions, if not sometimes also to the four dimensions, including time and possible transformation.

There is no doubt that it leaves more to the imagination (and therefore tends to stimulate it to subjectively construct a spatial event with the characters of recognizability synthesized in the formal gesture) a two-dimensional drawing than a three-dimensional model. Even when the representation, far from presenting itself as a hasty and synthetic note, presents itself with all the characters and codes of a canonical orthogonal plan and section drawing.

Very often the graphic note, besides being two-dimensional, is not even traced with all the accepted rules of canonical representations. The scale, first of all, but also the perspective correctness if, as is most of the cases in architecture and design, it is a drawing of allusion to the three dimensions.

But the idea that the sketch carries doesn't suffer from these limitations. On the contrary, what cannot be (or deliberately is not) described explicitly enters the field of allusions. It opens the way to possible, subjective and contingent interpretations. And sometimes these interpretations are so different from each other that it is hard to think that they are derived from the same image. If it is a matter of communicating an idea to another person, this can serve to present the critical facet that one wants to communicate in a context that the recipient of the message constructs itself. It is, therefore, perhaps, much stricter as a communication, as it refers back to the recipient everything that is not essential, and tends to work on the concept/expression of meaning on which one wants to focus attention.

But this also happens in the project notes that an architect draws for himself, to reflect on his own idea, to develop his own design path.

In this case, the ambiguity of the image produced becomes the essential vehicle for the continuation of the evolution undertaken.

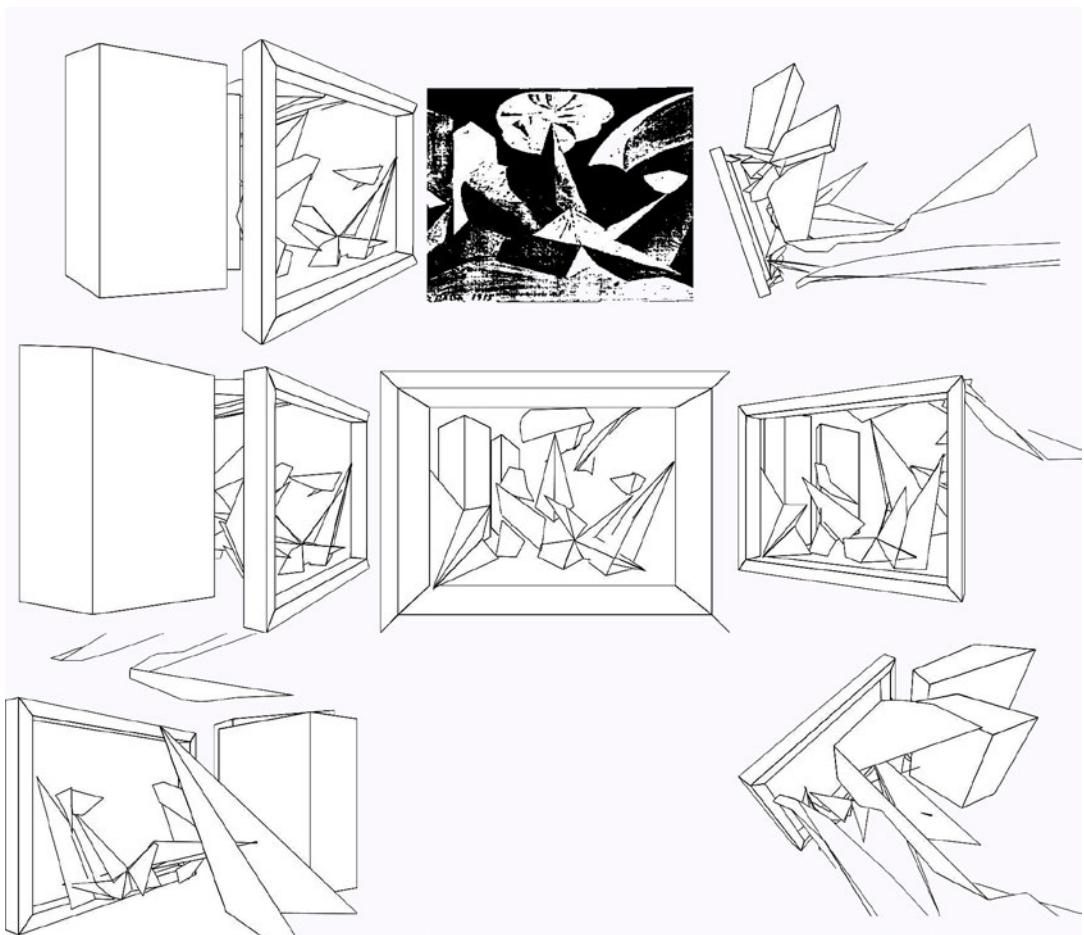
Tracing a note, the designer identifies the central event around which he wants to rotate the next moment of the development of the idea, formalizes the catalyst capable of orienting the space, and around this element produces forms with a strong charge of ambiguity. It will be the designer himself, when he will use the tracing to reflect on his project, to construct mentally, and contextually, the three-dimensional space only alluded to. And he will build it each time in a different way. Because each time his approach will be partly subjectively oriented (and therefore susceptible to a conceptual evolution of

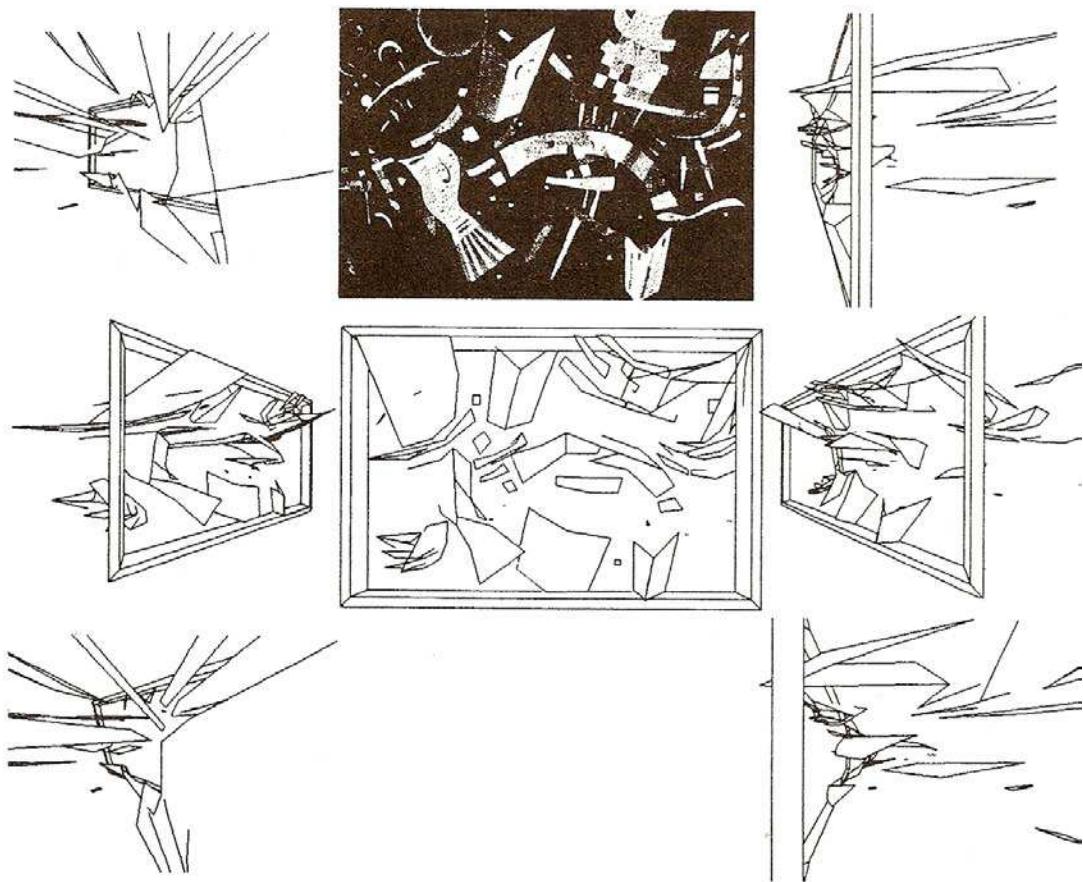
the same idea he is pursuing), partly also random and contingent, due to chance, mood, state of mind, etc..

The more allusive, tendentious and, at the same time ambiguous, the more useful the design evolution of the idea will be.

Experimentation in this sense can also be carried out on the same images as the works of art [1/2]. They are certainly not graphic notes, they do not have the immediacy of a three-dimensional gesture of allusion but sometimes possess the same qualities.

*Note 1. In the images, a three-dimensional interpretation reading of a painting by Balla made with the experimental software TRACCE, designed by Celestino Soddu.*





*Note 2. V. Kandinskij. Reading and constructing a three-dimensional model of subjective interpretation. In the images, the model is viewed from various angles, including some views from the back. Processing with C. Soddu's TRACCE software.*

This is perhaps due to the fact that not being architectural drawings, or rather not being drawings executed with critical and/or design intent on the conformation of artificial space, they deal with the latter in an instinctual way, amplifying the emotional aspect on that of a circumstantiated communication of volumetric, spatial and material characters.

Or also, as in the case of Giotto who, as is well known, was also an architect and therefore undoubtedly careful to three-dimensional connotations, the representation of architecture becomes deliberately allusive and ambiguous (let us remember the impossible drawings of walled cities) with the precise intention of provoking a subjective, but oriented and tendentious reconstruction of the represented environment.

If we try, using graphic or computerized procedures, to reconstruct a three-dimensional model from an allusive two-dimensional image to a spatial situation, we are faced with different and sometimes surprising results.

If then, as in the case of Giotto's images and in general of works around the 14th century [3], the perspective distortions are deliberately accentuated, we could also try to discover possible complex interpretations of the represented environment. However, even if each of these readings is strongly subjective, strongly interpretative, we can easily find not only a possible spatial thought of the author, but also the allusion, concretely represented, to possible evolutionary dynamics of temporal transformation of space.

It is possible to make a further evaluation, even if with this we do not intend to propose "truthful" readings of art history, but only subjective interpretations and readings of what historical-artistic works are for us, contemporaries, who operate on space/time form outside of any philological temptation. That is, we are tempted to find in the paintings of Giotto and Simone Martini [3] an attempt to represent time as a simultaneous facet of space. The same attempt re-proposed at the beginning of the century by the Cubists.

But if with the same system of tendentious and subjective reading of a three-four-dimensional space in a two-dimensional image, we approach works of abstract art, we can have extremely interesting results. Not as a critical reading of works of art, which belongs to another ontological field, but as a tool for reflection on architecture and design.

An abstract image does not have precise references to the three dimensions. Very often it does not have any at all. Reading this image three-dimensionally, and reconstructing a relevant spatial model, the operator, in fact, performs an architectural project.

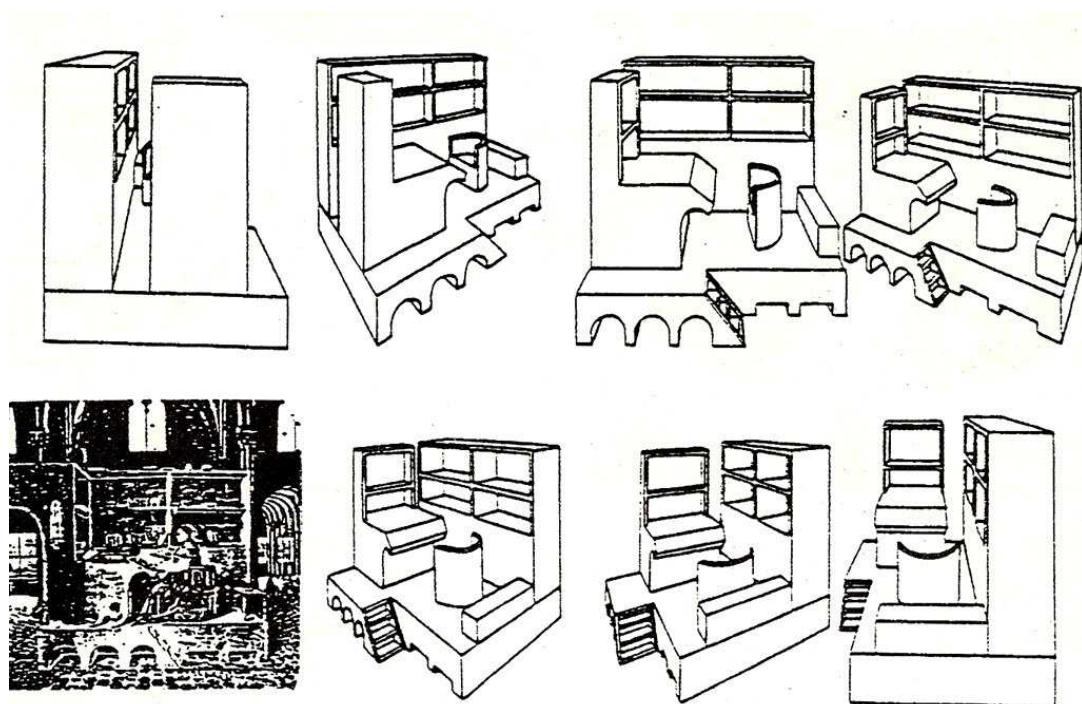
The subjective and/or random aspect in interpreting the various signs present in the image is, by far, more influential than the sign itself. Or rather, the interpretative reading that is carried out answers, in design terms, to the explicit request in the formal sign present in the painting. It is an operation that achieves one of the artist's own objectives: to succeed in making his signs fully understood as explicit conceptual requests. And also an extremely fascinating opportunity for the architect, who finally finds himself (not often!) a client who is both stimulating and pertinent at the same time, capable of making his requests play directly on the growth of the formal idea, of the architectural image.

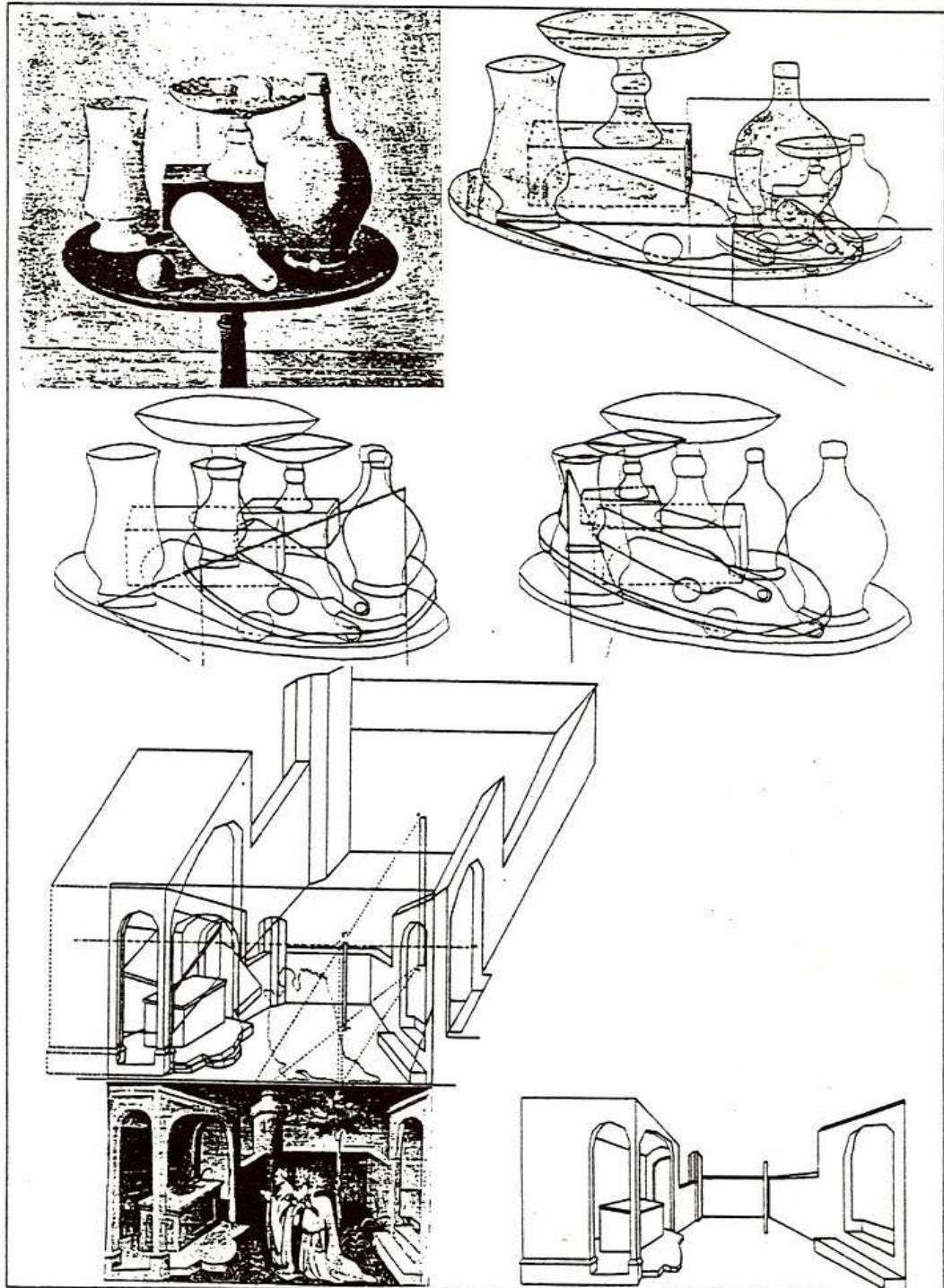
Note 3. see reading a table by Simone Martini in C. Soddu, "L'immagine non euclidea", op.cit.

*The images on the following pages are taken from the experiments of the students of the Drawing and Relief course held by C. Soddu at the Politecnico di Milano. They are reconstructions, based on subjective but "plausible" interpretations, of a possible three-dimensional space taken from two-dimensional images... The objective of these exercises is to stimulate the capacity of mental control of space. In this sense, in addition to the themes, such as the three / fifteenth-century paintings, which allude directly to the three dimensions, images, such as those of Mondrian, were used, which are difficult to interpret three-dimensionally if not by activating a creative 'design' thought capable of activating possible morphogenesis of form. In the images, in sequence, a reconstruction of the internal space represented in a painting by Antonello da Messina. The reading is based on the fact that the painting is built prospectively with canonical codes of representation, so much so that the*

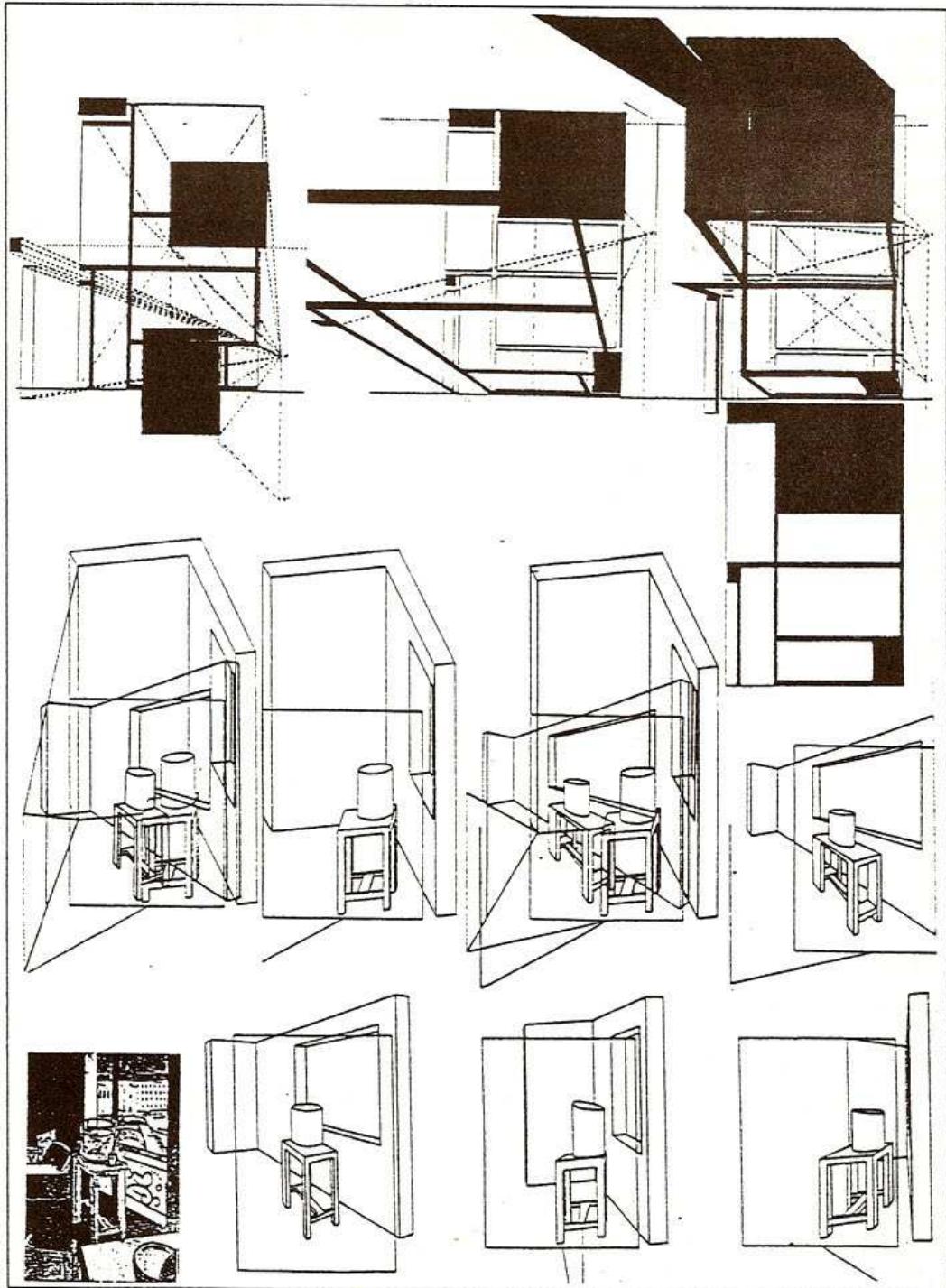
resulting interpretation traces an extremely plausible model; unlike the following work which, working with the same techniques but on De Chirico's Muse Inquietanti, generates, given the non-canonical construction of the image, a "parallel" but, perhaps, equally disturbing spatial scenario. The subsequent images are plausible stereometric reconstructions of a still life by Morandi and a medieval space, taken from a miniature of the Book of Wonders, spatially reconstructed. In the following experimentation, a Mondrian canvas is interpreted three-dimensionally, operating -projecturally on space, but following the artist's image indications. In the last reconstruction, a painting by Matisse read through a temporal sequence of a possible movement inside.

*Subjective reconstructions/interpretations of spatial allusions from two-dimensional images, realized as didactic experimentations Fig 1, Antonello da Messina (B Franchi). Fig 2. Morandi (M. Luzzani), Fig 3. Miniature from the Book of Wonders (J. Palmesino), Fig 4. Mondrian (J. Palmesino), Fig 5. Matisse (T. Fontanella). Fig 6. G. De Chirico, (L. Caruso),*





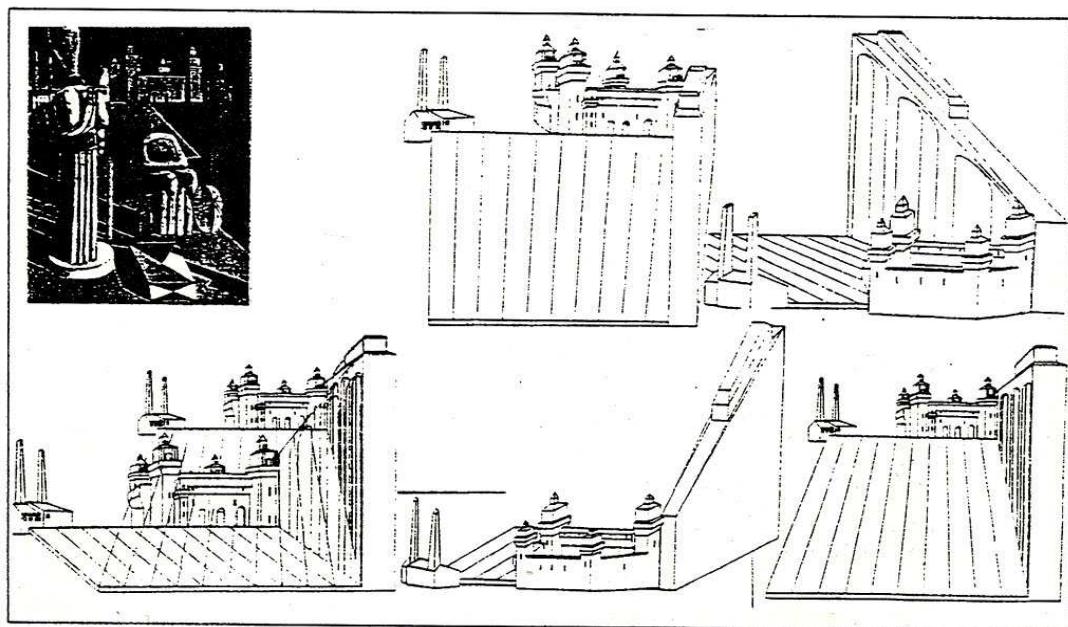
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Environmental Design of MORFOGENESIS. Genetic Codes of Artificial



## SIMULATE SPACE-TIME

The idea that it is possible to enclose the infinite in a drawing, and then work and reflect on this endless space by finding the visual image of one's own imaginary worlds, is the basic idea of perspective construction. If this virtual world thus traced succeeds in alluding not only to spatial dimensions but also to temporal ones, then the imaginary becomes passable in time of perception and transformation.

But all this is not so obvious. The fifteenth-century perspective built by simulating the visual image through a flat-screen on which the trace of the luminous object/eye paths is stored has always been loved and hated at the same time. On the one hand, it was the advanced instrument of a total and progressive control of spatial infinity, on the other hand, it denied this very possibility, forcing the representation to sometimes intolerable limits.

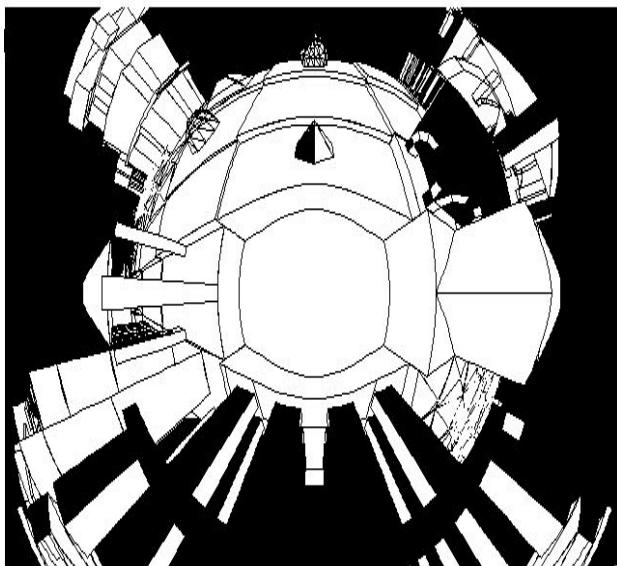
Limits that involve both the quantity of infinity that can be represented simultaneously and the truthfulness and verisimilitude of the image produced when it has been deprived of the temporal dimension.

It is not by chance that the first curvature of space/time is due to some fifteenth-century perspective experiences, and in particular to Leonardo, where the progressive shifting of the firs of parallel lines was used in relation to a presumed dynamic of time reading.

In order to represent the environment, and therefore simulate a virtual progressive approach/introduction into the represented space, progressive adjustments were made to coincide with a curvilinear distortion of the same space once temporized.

Lo spazio/tempo ed il suo controllo globale è stato, di fatto uno dei miti dell'era moderna che nasce con la prospettiva quattrocentesca, esplode con Einstein, e si chiude con l'avvento degli elaboratori, di strumenti che rendono finalmente possibile la rappresentazione, e quindi il controllo, della multidimensionalità.

The strange attractor (usual mathematical connotation of representation in coordinates of the possible or experienced states of a chaotic system) is the representation of the possible infinity becoming of an unpredictable chaotic system. It may seem, at first sight, a simple three-dimensional representation, because it is built on a system of points on three spatial coordinates, but, on closer examination, everything is much more problematic and surprising. At subsequent enlargements, it turns out that the lines it is formed of are not continuous lines but discrete point systems. And this leads us to find a fractional dimension similar to that identified for fractal forms. Moreover, at progressive enlargements (perspective close-ups?) we find the re-proposal of the same shapes at different scales, never managing to reach the bottom. Each point, enlarged, reveals to be composed of an infinite set of other points, all placed discreetly and never linearly in space and all responding to the same logic of mutual relations.



*In the figure above and in the following 3 images, the virtual models have been drawn in an anamorphic perspective similar to those used in the 16th century, with an experimental software designed by C. Soddu. The images use a reading interface formed by a cylindrical mirror to be placed in the center of the drawing. The totality of the space along the 360 degrees can be perceived by looking at the image reflected by the mirror while a circular path is being created.*

Like perspective, but going beyond spatial dimensions alone and systematically involving time, the attractor is a perspective representation of infinity. But it is also a representation that can only be expressed through a tool like the computer, in which the image is not the pixels turned on in the video, but the mathematical model itself, the algorithmic structure of the perspective narrative that lies at its base, and that intervenes in every possible "widening" of the image.

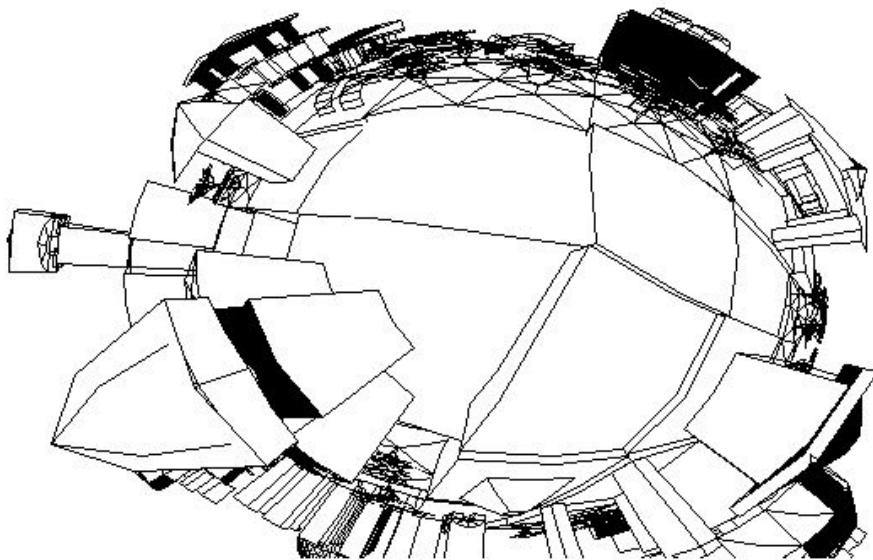
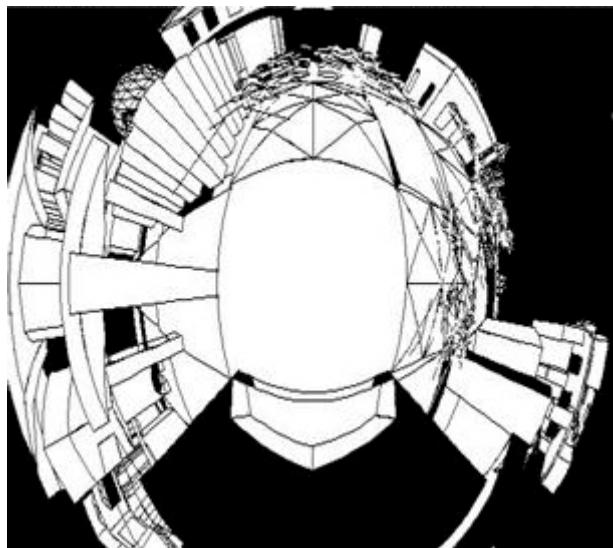
Returning to perspective, and in the light of these technical possibilities of representation, one can ask oneself if it is not possible to experiment operationally with hypotheses that have always remained on the margins of the custom of drawing due to objective technical difficulties.

The fascinating world of anamorphosis, which produced, in the 16th century, exciting drawings of "total" representations of space, such as Chinese or Flemish ones, could finally enter the daily use of those who design space.

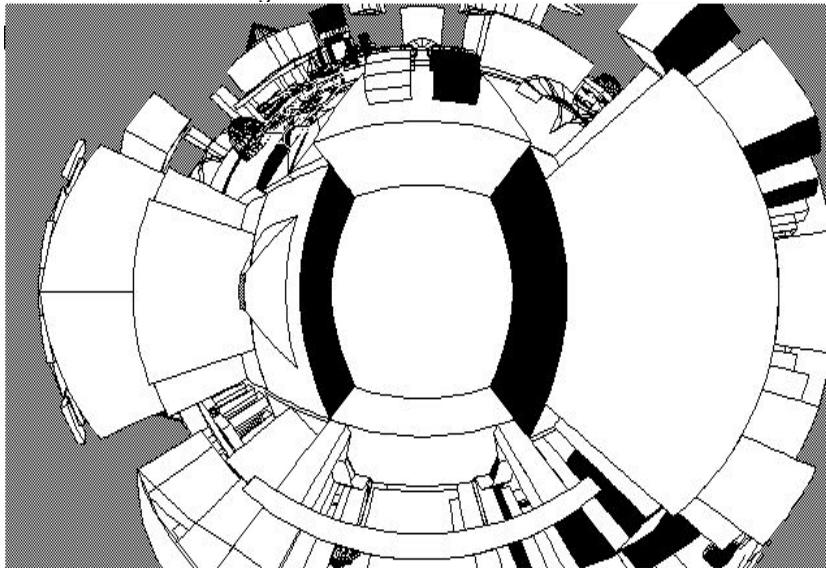
Moreover, the conventions used by two-dimensional representations of three-dimensional allusion are not innate. An axonometry is one of the most abstract and difficult to understand representations for those with different cultural references.

It is much more immediate and used for example by different cultures and for a long time autonomous, a representation of the three-dimensional object that traces all the surfaces that compose it in a continuous way, privileging the characterizing ones. According to this archaic and instinctual culture of representation, an elephant is drawn

as its skin is open and stretched out on a horizontal plane, or a staircase with a broken line that traces the shape of the steps (in section, because it is more characteristic) followed by a rectangle that traces the shape of the landing (in plan because it is more controllable and measurable).



New forms of three-dimensional representation (and why not four-dimensional) could enter the custom and be understandable and usable also in design thinking. After all, the current systems used for three-dimensional simulation design create many problems and limits.



First of all, they do not meet the expectations of communication and control of spatial infinity.

Perspective, in exchange for verisimilitude with vision, obliges us to work on space from a distance, as if we were obliged to use the telescope. It forces us to use excessive distances of the observer with respect to our daily relationship with the lived space, on pain of an uncontrolled acceleration of distortions and/or intolerable fixity of the eye/foil relationship.

As is well known, if we try to represent a space that exceeds, in its relationship with the observer, a certain (and very limited) visual cone, the representation is considerably distorted unless the eye (and only one eye) is placed in a precise point. To represent a space a little larger than usual, a drawing is often used which, placed in a box, can only be observed through an orifice.

However, the space represented by a traditional perspective simulation cannot, objectively, exceed a plane angle, i.e. half the virtual space. And if we try to communicate and control the infinite space, we cannot easily be satisfied to arrive, at the limit, at half of this space, even if this half is also infinite.

Therefore, taking old roads interrupted by technical difficulties, and using current tools, we tried to make representations of total infinity and, later, to see if it was possible, getting used to these representations, to use these systems manually to make sketches of communication and reflection on space.

The technique used starts from a first consideration. The totality of the space can be represented only by an observer placed inside the space itself. And this coincides with the pressing need for adequate tools of representation on the part of space designers, such as architects, who do not have the possibility of simultaneously controlling, with a single representation, the totality of a space seen from the inside using a realistic simulation (connected to vision). Either they are content to see the space from the outside, or they are content with a partial view of it.

But if with the computer it can be possible, and even easy, to represent the virtual world in a sphere, the representation of the sphere itself is extremely problematic. And it always has been.

Just think of all the devices used, and always inconclusive, that is used to represent

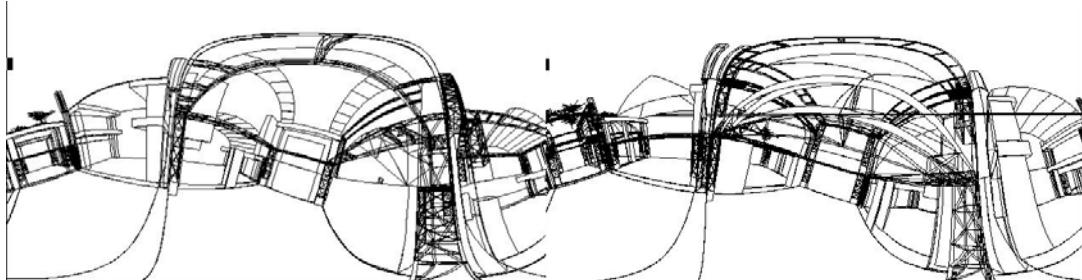
the planet.

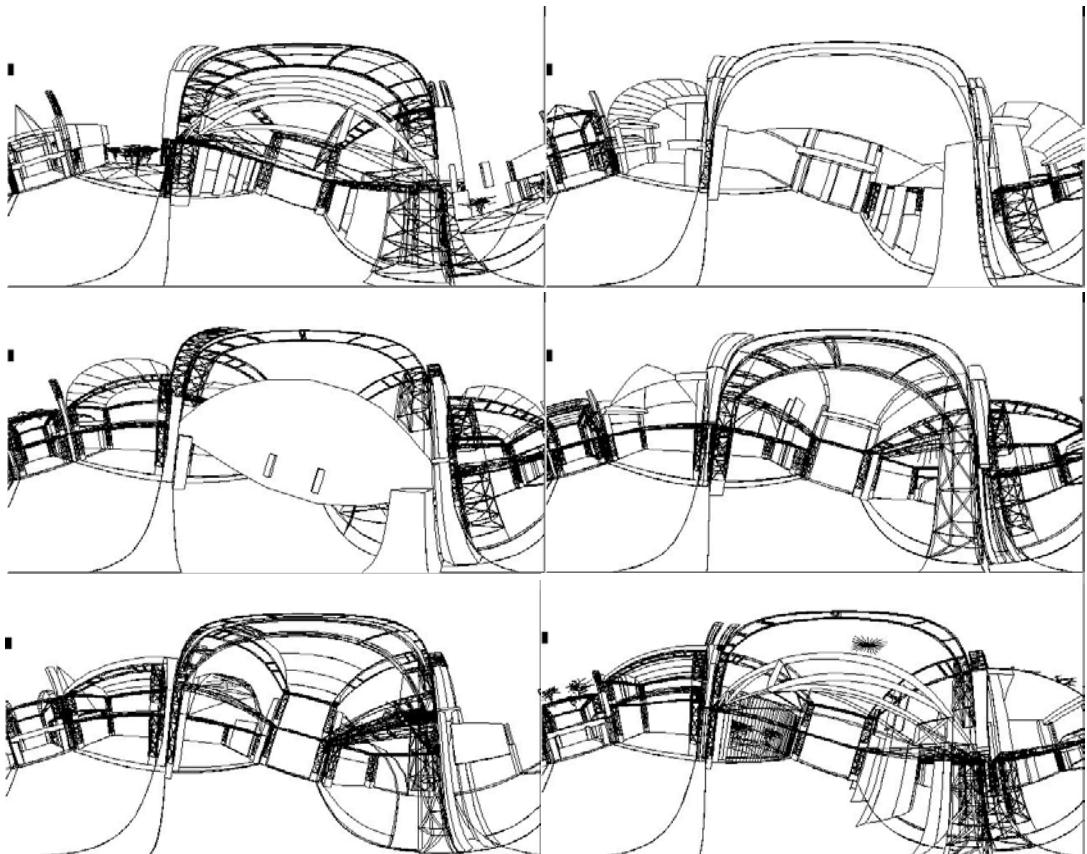
As in the maps, therefore, we used one of the possible anamorphisms, the cylindrical one. Renouncing, in this way, to represent completely the totality of the space, since the upper and lower portion of space included in the same cylinder is missing. The fact remains that, however, the portion not represented, that is the bases of the cylinder, can be relatively small at will, at the same time lengthening the cylinder itself. With this, it is possible to reduce almost completely space not considered. But the cylinder has the advantage, unlike the sphere, of being easily opened and transformed into a drawing sheet. Moreover, with this operation (unlike, for example, a conical interface, also used in the 16th century) the stretched drawing is more comprehensible and directly assimilable as it preserves the width/height structure of the traditional flat perspective.

A representation of the space on the cylinder takes place through an infinite multiplication of micro perspectives, each one for every single point of the cylinder, with the optical axis each time centered on the point itself. The result is, graphically, difficult to reach manually (curves are not arcs of a circle, and therefore not easily controllable with graphic mechanisms), but, as an image, intuitive enough to be used to draw a sketch, a graphic note.

The lines that represent straight lines, in reality, are in fact curves in the plane of the cylinder, and therefore in the sheet. And this is a problem because we are used to reading straight lines in drawings as straight segments. But it's a habit, that's all. The curves of the total cylindrical perspective are particular curves: they are images of straight lines that respond to our dynamic vision.

*In the following images some virtual models of the TERME morphogenesis project represented in a total 360-degree perspective. The image is seen by an observer placed in the center of the represented space and with his eyes tilted upwards (and also downwards, because if I look upwards when I turn my head my eyes turn downwards). These are therefore representations of the totality of space in which the sequence of possible perspectives of a rotating temporal reading are synthesized in a simultaneous image.*





In fact, when we walk along a corridor, and look first in front of us and then behind us, the lines, parallel to each other, that mark the length of the space first converge towards the end of the corridor then when we turn around, they converge towards the beginning. They, therefore, have two escape points. And necessarily, since they are distinct from each other, they are curves. But the curvature is generated by our turning our heads. Time has "curved" the straight lines.

In total perspective, the same kind of curvature happens. If we look at a straight line from the center of the cylinder, it is seen as a straight segment, because the curvature of the track on the sheet and the curvature of the cylinder compensate each other anamorphically.

When we turn our eyes, the straight line, drawn in the surface of the cylinder like a curve, always remains, at sight, like a straight segment. But it varies its inclination. It is the anamorphic effect realized in the dynamics of perception.

In fact, the curve drawn on the surface of the cylinder is the trace of a dynamic of rotation, synthetic with respect to possible temporal unwinding. A sort of virtual story that can be followed at will to reconstruct an ever-changing formal tale.

And if we look at the drawing as a plan, after having stretched the image, we are able to capture this temporal synthesis. The stretched image of the cylinder of total perspective, as an instrument of communication and simultaneous control of space, is, in fact, more interesting, more pregnant than its use as a dynamic reading interface. In fact, it allows us to appreciate, and control designally, the simultaneity of possible temporal

dynamics, the totality of spatial relations between elements and, what interests and fascinates us most as architects, the relations between the before and the after of possible reading paths.

The curvature of the lines seems almost natural to us, after all, the possibility of imagining them straight is a passage of usual formal transformation, an anamorphism with a curved interface to which other and increasingly frequent occasions and practical and theoretical frequentations have accustomed us.

#### Morphogenetic simulations.

If the three-dimensional simulation, through the total perspective, gives us the possibility to represent, and therefore control, some temporal dimensions of the lived and designed space, this is not exhaustive when we intend to insert the time dimension in our design work, representing the evolution of the idea.

At the same time, we realize that the evolutionary/temporal aspect is not marginal in the project. It represents the most specific and relevant field of work, it is the engine of the project.

Every project approach, every methodological choice, however particular and subjective it may be, is always a logic of management of transformations, of morphogenetic processes of progressive shift from one form to another, from a previous paradigm to a subsequent one, along a path, sometimes unpredictable, tortuous and conditioned by contingent and random events, but still aimed at achieving certain objectives. But even these objectives are in transformation.

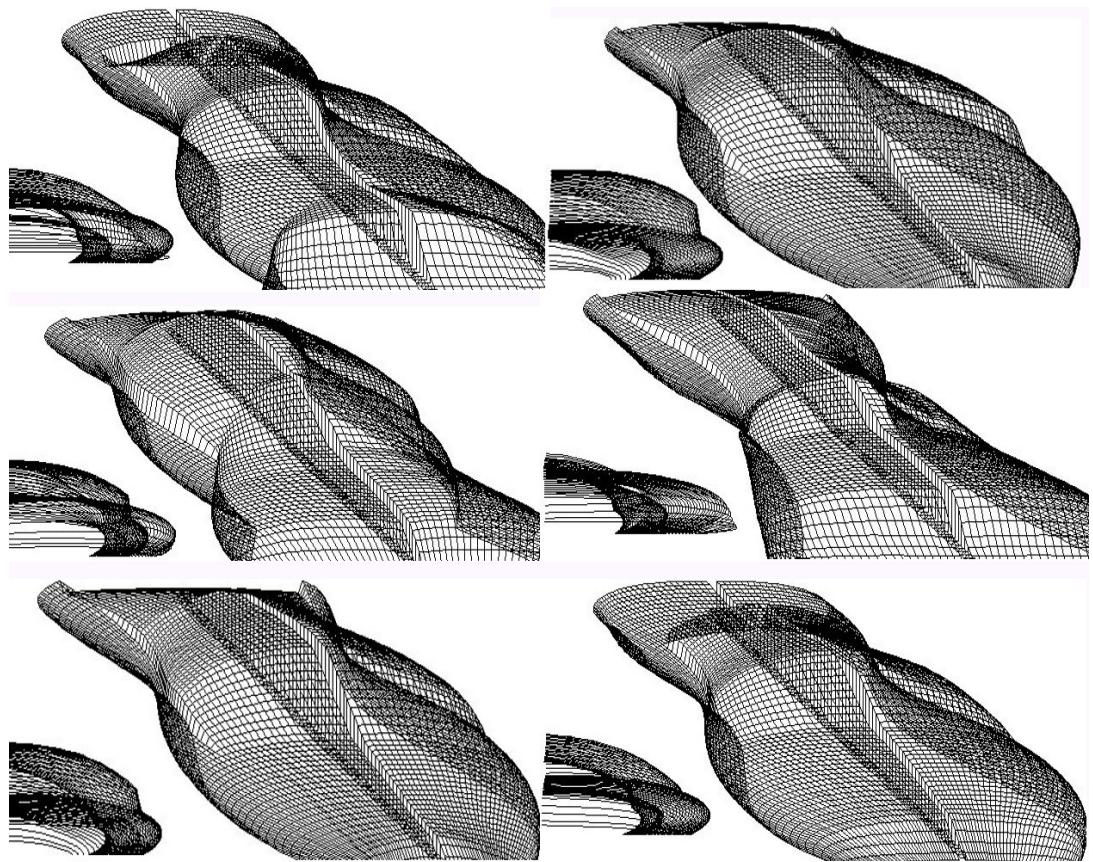
The virtual imaginary to which the project tends, and which is the real reference and qualitative meter of control of choices, is also in the evolution. The path to be taken by the project, as a qualitative differential between the imaginary of reference and the state of progress of the project, is, in the best-case scenario, destined to be progressively reduced. But it will itself undergo a progressive shift towards progressive increases in complexity. The partial results achieved, in fact, only raise the pitch, since each choice is also readable as a re-proposal, at a more sophisticated level, of the basic requests that generated it, with the addition of excess responses, due to the explicit, contingent, conceptual needs of the designer and the particular historical, cultural and casual moment in which he is working.

Design is, therefore, work on what is transformed, a pursuit, prediction and management of the unpredictable, an answer to questions that have not yet been asked, and that perhaps no one will ever ask.

All the materials of the project are unbalanced, from the demands that evolve to the technology that transforms, as they ask questions to the designer. If no more questions were asked, if a stasis were to be established and the expectation would cease to exist, the project would no longer even exist.

If designing is to work on what is transformed (the needs, the city itself, the history), the tools that should be used to design must be able to represent, design and control this evolutionary dynamic.

And this is the great contemporary challenge. If until now we were not able to work in real-time with transformations, and we had to be content with mentally reading evolutionary aspects from representations of individual states of equilibrium, even if sequential, today all this is possible. And it has been implemented and experimented in other disciplines.



*The images are related to the morphogenetic dynamics of an artificial form. The example is taken from the morphogenetic matrices of C. Soddu's Auto species project. Each scenario takes into account the characters of the species as they have been identified. The proliferation of possible "individuals" controls the possible evolutions of the design idea.*

If we work on the environment, a dynamic model of the evolution of architectural, urban or individual objects of use is not only possible but becomes necessary to adapt our design potential to the incessant and accelerated rhythms of transformations and cross-communication of today's era.

But it is not only a question of speeding up the operational times needed to achieve the set (but elusive) quality objectives. It is above all to operate directly on the core of the design "invention" without delegating to laborious conceptual interconnections the reconstruction of the dynamics proper to the evolving system we are tracing.

If we build a dynamic model able to represent and simulate, the design logic that we intend to adopt, this allows us to control both the evolution of the project, through the continuous creation of possible future scenarios that each of our choices involves, and, through this proliferation of virtual models, to control the growth and complexity of our imagery of reference, and then the differential state of fact/objectives that measures the quality and the path still to be completed.

All this still belongs to the field of representation, to the park of instruments to know and control the environment in which we live. But it widens the disciplinary ontological field, reconsidering the representation as a simulation tool through dynamic models, therefore as an experimental laboratory directly connected with the decision-making process, and able to prefigure the future scenarios that each choice, when adopted, involves

## **THE PROJECT**

The operational approach to the evolutionary dynamics of the idea



*"I will write my thoughts without order, and not, perhaps, in a confusion without a plan; it is the true order, and that will always mark my object with the disorder. I would do my subject too much honor if I treated him in order, for I want to show that he is not capable of it."*

*Pascal*

## **PROJECT TRIGGER**

### **FROM BALANCE TO IMBALANCE**

When we have to undertake a project we all feel a sense of emptiness, not just those who are at their first project experiences.

This even if we have, or think we have, a precise objective of our design, linked to a specific (and subjective) idea of the quality of the environment in which to live.

The sense of emptiness derives first of all from the fact that our conceptual reference is not yet design. Even if it is aimed at pursuing a possible environmental quality, it is theoretical, extremely complex and contains unstructured and formalized requests. It is, therefore, a difficult objective to express directly in a complex form, without this happening through a subsequent elaboration process, and therefore along with a design temporality.

The problem we face in transforming our idea into a project is related to how to proceed in order to make our hypothesis explicit, how to activate this process of elaboration.

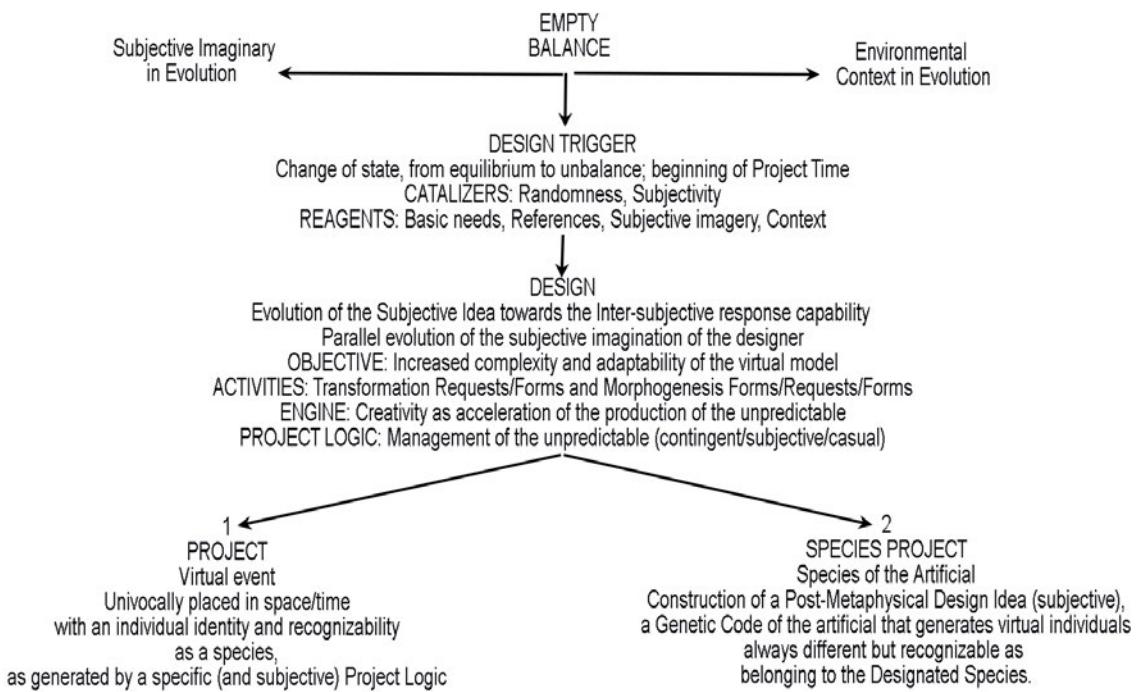
The initial loss in front of a project is not due to the lack of references, requests, or possible hypotheses. It is mainly due to the fact of being in a situation where everything, from the premises to the references, from architectural ideas to technological hypotheses, is immersed in a state of equilibrium.

And design demands a situation that is exactly the opposite of all that. Designing is controlling and at the same time supporting the evolutionary dynamics of an idea and can be evaluated, and operated, essentially on the level of transformation dynamics. It is the transformation of a series of events (requests, ideas, references) into an overall, complex and formalized event. Moreover, this process cannot be identified with its result, which is, necessarily, partial with respect to the activated logic. A final form is only an event, among the others that would have been possible, uniquely placed in space and at a point of time.

The feeling of emptiness, at the beginning of a design path, is essentially due to the need to change state, from a state of equilibrium to an evolutionary dynamic.

Only when this dynamic has been triggered can the project take place, and everything will be in the "norm", i.e. within a design logic, a development logic. This design logic is the specific and recognizable tool of each designer, which differentiates and identifies it among others. But it is a logic that deals exclusively with transformation, morphogenesis. It systematizes the tools for how to go on, how to manage the subsequent transformation of forms, until the final result. However, it does not directly provide indications or tools to trigger the project. And this is because it cannot do so since this field is outside the same field as the dynamics of design. It is as if the rules of thermodynamics were to be applied to understand and simulate the triggering of the Big Bang, what happened when the time of the universe began.

The problem, the operational methodologies related to design cannot be confused with those related to the triggering of a project. The two problems are extremely distinct, as they belong to two different logical worlds.



### How do we trigger a design?

Theoretically, we have to put something in our system in balance, capable of triggering a process of transformation. Once the process is activated, it will be possible to control it through design logic.

If it is a chemical problem, we can represent this first operation as the triggering of a reaction. It is carried out, normally, by placing a catalyst inside the mixture of chemical elements present in the system. This presence makes it possible to transform one chemical element into another. This happens, even if the catalyst does not appear directly in the process it activates.

Or rather, it appears neither in the reagents nor in the products, but only as a vehicle through which the event occurs. The transformation, once triggered, follows the rules of becoming, and takes place with the indispensable parameter of the time factor, which was not present in the previous phase.

Also to trigger a design becoming we have to insert the temporal factor and, probably, use a formal catalyst for this activation.

In the stories that designers make of their moment of triggering the project, of their personal Big Bang that begins at the time of design, it is clear that the catalyst can be any occasion, as long as it is capable of stimulating the formalization of requests.

As in chemical processes, very rarely does this catalyzing element enter directly into the transformation processes it activates. Almost always it is useful only for triggering and/or as a stimulus for the continuation of the transformation, but usually, it does not appear as a component of the results. In other words, the forms that this catalyst stimulates need not necessarily be retained in the project. They can only be forms of transition and, as such, acceptable even if they are not specifically relevant to the desired result.

If we let the designer speak, he often says that, in front of the blank sheet of paper,

he activates some possible occasions that often wander from casual to extremely subjective and humoral. He can tell us that he follows with a pencil the shadows that the sun forms with the objects on the table. Or he has the habit of putting under the semi-transparent sheet of paper still intact old drawings, magazines, newspapers. Others tend to break the balance of the white sheet with random images or abstract and improbable formal gestures. Tafuri tells us how Ludovico Quaroni, after an endless discussion with the other designers to start a project, suddenly hung a white sheet on the wall and, with a pencil, turning his back to the same sheet, drew a doodle on it saying: "Now we can start to design!"

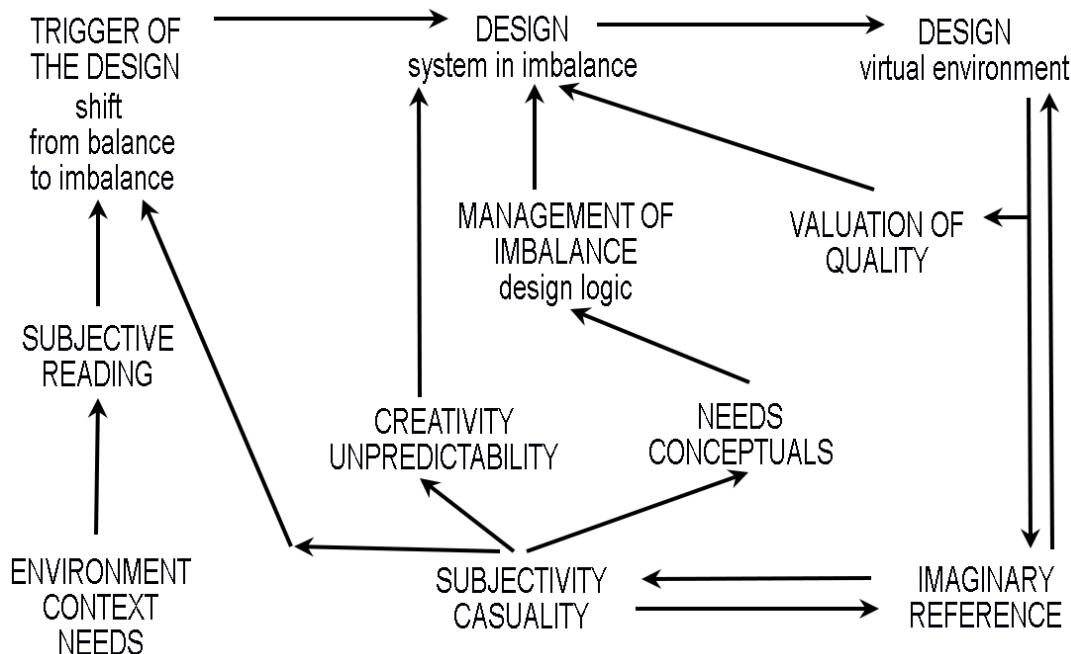
The important thing for everyone is to start the project, to activate the evolutionary dynamics of the form in order to finally be within the specific field of design. Very often the role of the catalyst is also given by previous experiences that have not found an end in previous projects. Even if the latter, for obvious professional needs, may have been closed and (perhaps) realized. In the new framework of requests, references and constraints, the old paradigm, not yet exhausted in its potentiality, regains quota, even if only for a moment. However, it is certainly not used as a pre-constituted solution, to be pursued stubbornly, but as a formal matrix useful to trigger the design progression again.

## THE ENVIRONMENTAL CONTEXT

### Possible Dynamic Models

In addition and in parallel to these tools, the coexistence, at the moment the project is launched, of a dynamic system that is already evolving and with which the project must continuously connect: the environment, natural or artificial, in which the new event will be placed. The reference context is in fact, unequivocally, in a dynamic situation of growth. And by triggering the project we should, so to speak, catch the train already in motion of the reference environment.

And this is not only for architecture, where the node of contextualization is explicit but also in the industrial design project where the context, even if variable, is in continuous transformation. In design, moreover, a second aspect of the context is also strongly present, which, on the other hand, becomes an indispensable reading key. The evolutionary dynamics of the object of reference read through all the transformations, evolutions and subsequent adaptations due to both new production techniques and changing demands.



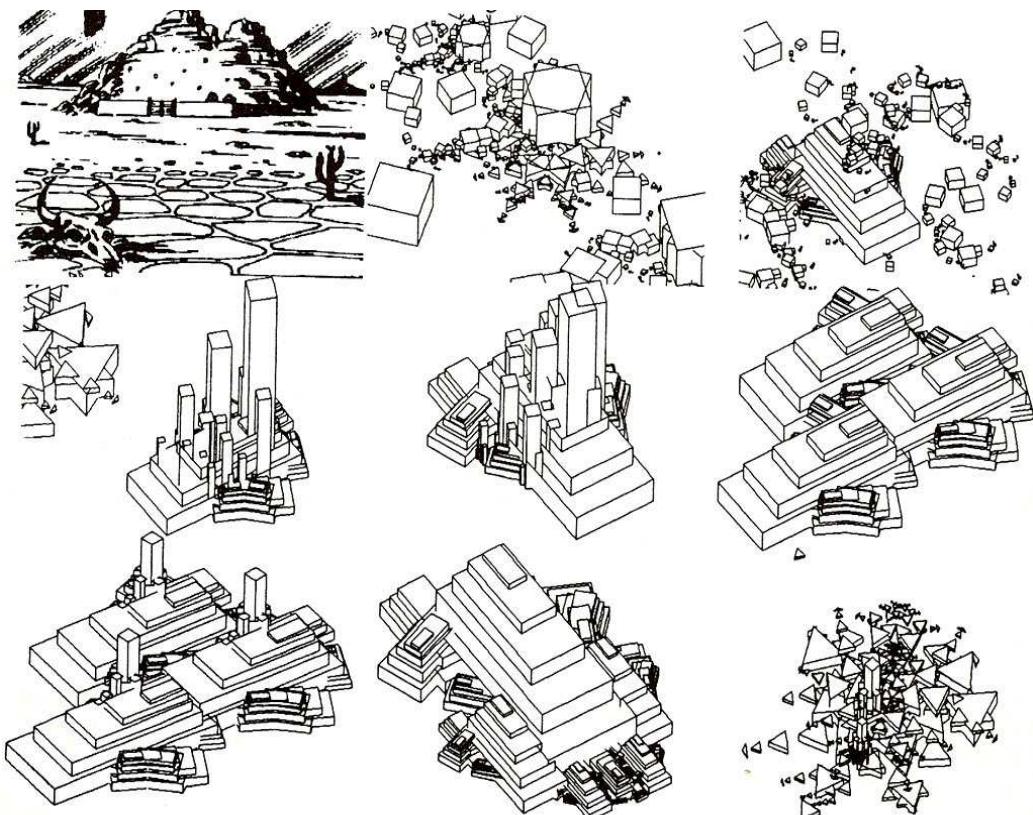
The project that grows and the environment/context that evolves are two parallel stories that, besides being intimately connected and interdependent, are also, structurally, very similar. They can both be told as morphogenetically evolving structures.

The approach to the context, moreover, must be carefully considered with regard to the plausibility and acceptability of the dynamic analyses that can be implemented.

If, in fact, there is no doubt that the context/environment of reference is in evolution, the evolutionary dynamic that we read, and propose as a dynamic model also capable of triggering the project, is the result of an extremely subjective evaluation and interpretation, whether it is an artificial or natural context [1]. This, fortunately, does not affect the validity of the trigger if, as in the previous examples, the trigger was activated by case. But it is obviously indispensable to be aware of this subjective charge.

It is, in fact, unthinkable that a dynamic redrawing of the evolution taking place in the context can correspond, make a truth explicit. It is, at most, one of the possible truths. Or rather, positioning of the events readable from a particular point of observation within a paradigm that is also subjective, and the result of our conceptual need for order. is a way of bringing out possible symbolic sequences capable of filling our imagination.

*Note 1. A subjective reading and reproposal as a dynamic model of a natural context. In the images, one of the experimental exercises carried out by the students of the Environmental Design course at the Politecnico di Milano, held by C. Soddu. The exercise is by the student M. Bruni.*

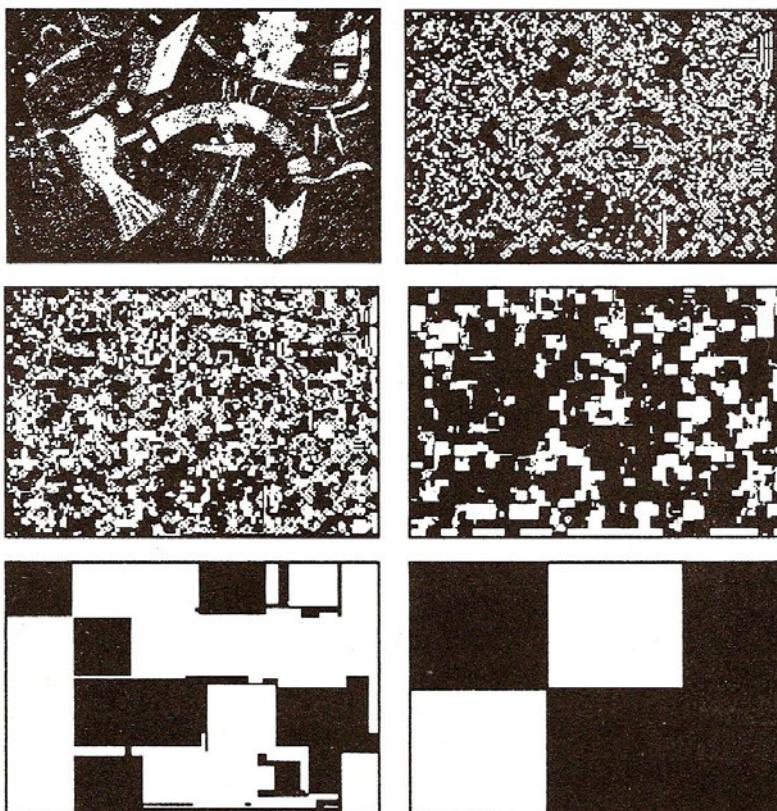


The subjectivity of the approach is made explicit through the image of a desert taken from a comic strip, which is used as a reference imaginary. In the construction of the dynamic model, the possible interchangeability of the formal matrices and, alternatively, of the logical procedures used for the simulation of morphogenesis processes in the context has been experimentally evaluated. In the results, it is possible to discern between the individual identity of each event, controlled by the formal matrices used, and the recognizability of the species defined through the morphogenesis procedures.

We, in fact, can analyze the evolutionary dynamics of the context through parameters and values that are interchangeable even before they are different. These readings may also not differ from the current ones, in this case taking an academically codified approach; but even in this case, it is difficult that they do not differ from each other at least for the hierarchical structure between the various parameters. But that is not all. In order to read a possible dynamic order, we identify units that we consider plausible and place them in a tree of successive relationships.

In other words, we arbitrarily identify units, possible individuals/objects/events that we recognize in a species and to which we entrust the task (a posteriori) of being carriers of a capacity of self-preservation/evolution of the same species. And we realize this systematization at various scales. We can identify as units (in evolution) trees, houses, but also woods, cities; or cars, windows, benches, car headlights in their technical/production development, and so on.

*Fig 1-6 Experimental sequence of progressive mutation of a Kandinskji painting made using iterative procedures. The last image refers to the 350th mutation.*



In other words, to analyze the evolution that has taken place in a context, or the evolutionary dynamics in an industrial object, for example, a car, we can identify units, for example, the headlights, the steering wheel,

the seats, the license plate lighting, and trace our reinterpretation of the morphogenesis that has taken place to date. All this is extremely useful and, perhaps, indispensable for the future growth of the project, but it is certainly not true. It is already, in some ways, a design orientation of the indistinct and static universe of one's own imagination. Anyone else, in fact, would most likely have used other possible units, neither more nor less relevant to "historical" evolution, and with those could have built a dynamic model just as useful even if different.

If then, instead of structuring our universe only with possible units (spaces/objects), we also try to identify the possible interfaces, the possible formalization of the connections between the various units, our model grows, out of all proportion, of complexity and subjectivity at the same time. It is not said, in fact, that in a rereading of morphogenetic dynamics, we cannot find a progressive emergence of an interface, a progressive accumulation of its identity so much that we have to place it in the field of spatial units, and vice versa.

But the reading/re-reading of a possible evolutionary code cannot only be based on plausible units and interface. The leading element of the imbalance is the system of relations, the organization of the sequences between the units.

The subjectivity of the approach makes us opt, in the reconstruction of a possible evolutionary procedure, for sequences in tune with our conceptual references/needs. We can be strongly motivated in facing each object as a prosthesis of man, and pour this preferential reading of the object - interface between man and environment, preferring the man/driving-wheel/wheel/road sequence to the more detached and abstract bumper/headlights/bonnet/passenger compartment/tail/license-plate sequence.

Each of these readings is, of course, plausible. But none of them is, fortunately, axiomatic and totalizing. Even in architecture, it is possible to approach the building with different approaches that prefer, hierarchically, the external-space/internal-space sequence or vice versa. There is, in this, the reflection of our conceptual references, of our need to create hierarchies in the directions of reading the sequences correlating, for example, the physicality of the light/shadow/dark sequence to the functional public/private one, to the symbolic one of holy/profane.

The usefulness of these re-readings of the context is based, however, on their strong subjective component. If it were an "incontrovertible fact" it would be unusable as a trigger for the project, indeed it would annul the very necessity of the project which should only be made explicit as an extrapolation of the exhaustive dynamic thus defined. Being instead of a subjective design, it will tell the first possibility of development, it will become the first circumstantial paradigm that, by its nature, is all the more effective the more it is open and not axiomatic, in other words, it is willing to increase its complexity.

## **EVOLUTIONARY DYNAMICS**

The control of design c

But let's get back to the project trigger. What happens a moment after a random, subjective form, or one that, however, did not want to be decisive for the project, has started the dances?

All the elements, until then uniformly diffused in space, mental and timeless, of the pre-project, begin to look around and place themselves. The catalyzing form positions them, orients them in space and provides them with possible directions for development. This catalyzing activity is comparable to the emanation of a scent of seduction for the other elements present in the timeless space of the pre-project.

The time of the project starts with some elements/requests that, attracted, migrate towards the already oriented element and structure ideas of possible interfaces, forms of possible relations, synapses suitable for possible connections.

These elements, in the first phase, are nothing more than the project's own requests. And the interfaces are nothing more than the first proposals of formalization. It is interesting to note how time enters in a decisive way into the design. Each interface exists in the history of the project only for the moment that it is formulated, formalized and accepted. A moment later, once a choice has been made and the request has been made explicit through a form, this form is nothing more than a further request to the project, even if structured on a more sophisticated level. Each form, the result of a response, returns to a more sophisticated request and migrates again to structure a further interface.

Every migration that an element carries out, therefore, produces a possible interface. If in the evolution of the project, the two elements are subsequently disconnected, the presence, the memory of that possible interface, will remain. And it is not excluded that just the presence of that possible formalization, the interest to reproduce it, pushes to other, unpredictable, connections between elements.

And with these first transformations/evolutions the time of the project, its own history, unique among the other possible ones, begins to affect the subsequent complexity of the possible results. But the difficulties of this first moment of the design experience are many. First of all, the risk of finding oneself, due to an error of evaluation, immediately locked in a new balance, and then with the need to re-start, find a new catalyst, to revive the design process.

The second difficulty is inherent in the need to operate simultaneously, especially in this first phase, on a plurality of scales and a plurality of disciplinary references. In order to ensure that development takes place on all the various levels of a project.

It is, in fact, possible that the design retains its dynamic and propulsive thrust in some scales of intervention, and instead is rapidly reduced in others. If this happens, the coagulation of possible static enclaves within the evolutionary process, even if limited to specific scales, leads to the death of the project. And the block can rapidly propagate from a scale, even a small one at the beginning, to the totality.

But when do you turn off the project engine? Evidently when it is no longer able to evolve. It is likely that this can happen when the hypothesis adopted is excessively schematic and can no longer respond to the incessant increase of further requests that arise from within the same project, and despite this, the designer persists in not changing it. Or in the case that the designer is no longer able to grasp the requests that the same forms adopted pose to the project, even if in a more sophisticated sphere of reference. The project stops before reaching the results sought when the designer can no longer find new design opportunities.

It is therefore appropriate, by activating a design experience, to trigger the process on many levels, involving in parallel the various fields on which to operate. For example, start time simultaneously on some component elements and on the whole. And this also in view of producing a non-linearity of the evolutionary process and, in perspective, complexity.

In other words, if we have a building as the theme of our project, we can (as a preliminary step and without the need to be coherent subsequently with the options adopted) identify some events that may be present in the architecture, and trigger separately, and even independently, processes of design evolution on each of these elements.

In particular, we could make the total architectural image, the individual spaces and the interfaces between them grow separately. In this way, we will have more elements in play, and therefore more possibilities to keep the engine of our project running. The initial choices can also be the most random. It is important in any case to produce them in order to increase the possible keys of interpretation. This is the role of creativity, even if many, and perhaps most of these partial choices made will not remain in the project. They will, however, act as catalysts in the possible subsequent evolutions of the architectural idea.

If, for example, the project is related to a school building, we can activate possible sub-projects related to the classrooms, the main hall, the corridor as an exchange space, the garden/patio, and so on; but also, simultaneously, on the total image of the building or, at a completely different scale, on the character of the openings as internal/external interface. Even without immediately evaluating the possible necessary connections between these events; indispensable evaluations when they really have to be an integral part of our architecture.

On the contrary, if the partial choices made at this initial moment are not reciprocally connected, even contradictory with each other, they will offer, precisely because of this preventive not-homogenization, a guarantee of producing imbalance, therefore fuel for the evolutionary process.

To those that are placed as basic requests (dimensional, functional, cost characteristics, etc.), and that we place as "elements" of our universe still static, we add a whole series of other requests, even mutually contradictory, that we do not assume all as necessary, but that, because they come from our subjective imagination, begin to build a first layer of meaning on the virtual environment that we are drawing. At this point the first reaction is started: each of these added elements/requests may be able to orient, magnetize the static universe of the pre-project.

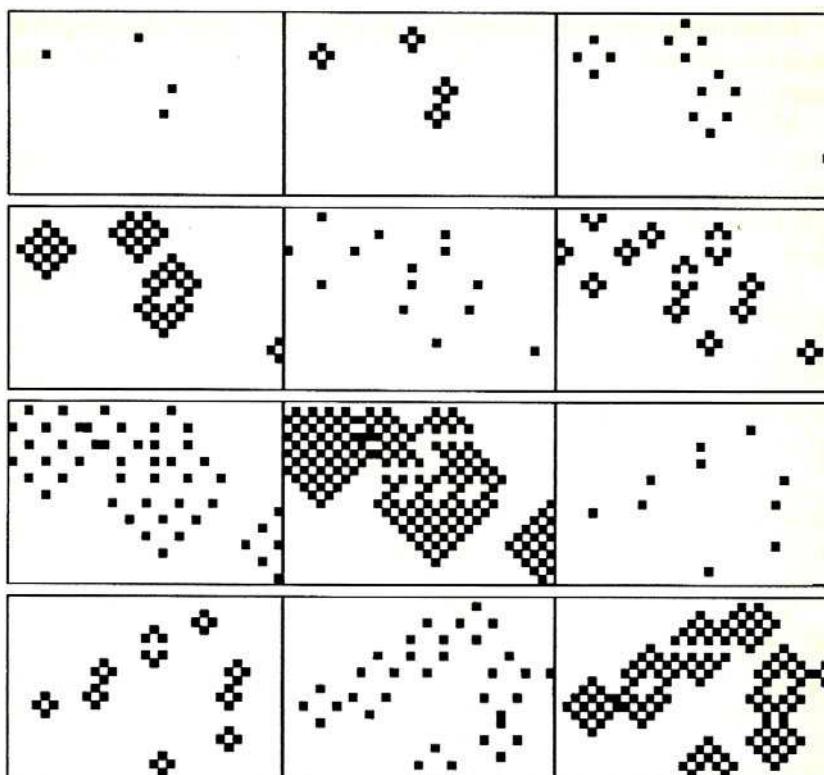
It is enough to start to represent one of these elements that the field is oriented along one of the possible geometric traces that are typical of the catalyst. This is enough for each successive reference to operate on the pre-existing modifying it and structuring successive forms, due to the approaching and merging of the various references.

The purpose of this first work, which should be repeated many times starting alternately from one element or another, is not, and should not be, the search for the solution. The purpose is twofold. On the one hand, to eliminate the detritus of categoricity that references, both historical/cultural and random and

emotional/subjective still possess. To bring out what, already from before, they implied: the facet capable of reflecting and realizing our idea of architecture, of an object, of a city.

The second aim is to produce stimuli, successive requests to satisfy, complexity. The forms that, formalization after formalization, we produce, in addition to losing more and more the ability to identify and allude to the reference used, will produce contiguity, situations, opportunities for further formalizations. Therefore, events that, posing themselves as possible further requests, will be a stimulus to the evolution of the project.

The random and implausible references, those elements used so far as unbalance activators, will then enter into a process of subsequent downsizing that is precisely the role we had given them, that of catalysts. They will have been the vehicle of our design thinking, not an aim to be achieved.



*In the images, an experiment by the authors on the evolutionary dynamics of Stanislaw Ulam, which simulates the reproduction of successive generations. Individual systems evolve linearly until they resonate with neighboring systems, generating forms in which the relationship between order and exception becomes increasingly complex. The system, however, maintains global recognition due to the same type of procedures.*

*Note [1] - As already explained above, two linear dynamic systems, in contact with each other, produce resonance, in practice a new non-linear dynamic system. Therefore, at the limit, it creates new opportunities for creativity. Ref. R. Thom op.cit.*

## QUALITY

### Definition of objectives

If all this has served to trigger the design, everything we have done so far is not yet designing. We are in fact facing a universe that comes alive; events, forms, requests, references that collide with each other; but still a universe that does not proceed according to a specific and identifiable evolutionary line.

Designing is, in fact, this: activating a logic of development capable of controlling the evolution of the system towards a goal. The difficulty consists in the fact that we do not yet know this objective. It is true that we know some of its attributes, such as to define, in negative, the degree of quality, but we do not know how these attributes can be expressed in the artificial form that we are creating.

To design is, therefore, to control a dynamic process of development without knowing exactly where this development will lead, but assuming only some qualities of this possible outcome, such as compliance with the subjective imagery of reference, also in transformation. On the contrary, it is necessary to be aware that, if we thought we had configured exactly the final goal to be achieved, we would stop the design process itself. And if this happened too soon, immaturely, we would have aborted a result without quality, a result still too tied to partial and strongly categorical visions in their acerbic subjectivity, unable to respond adaptively to the possible and unpredictable demands of man.

Designing is controlling an unpredictable process in the specific characteristics of the contingent results, but predictable, indeed desirable, in the qualitative characteristics [1] of the results themselves. The proper field of design activity is to activate a control logic. it is to define a mode of behavior with respect to contingency, randomness, the proliferation of requests and complexity. it is to delineate a further (and subjective) scale of values, always in transformation, such as to allow us to make, in progress, hierarchical choices between simultaneous events; which are always different and tend to produce adaptive responses.

In fact, our aim as designers is to structure what is commonly called an unpredictable evolutionary dynamic system, a chaotic system, able to proceed towards complexity in such a way that every outcome, however different, will always be recognizable by the connotations of species, by the recognizability of the logical approach implemented.

The same design story that, in the face of an unpredictable series of contingent events, will take place, will always be one of the possible parallel stories virtually possible, and recognizable by the same approach to the random, to the unexpected.

*Note 1. Total quality as the answer preceding the possible question, a full-field answer using symbolic mediums capable of containing a multiplicity of possible meanings*

## **INVESTIGATIVE PARADIGMS AND SUBJECTIVITY**

The next step after the start of the project is, therefore, the activation of its own design logic. Which will obviously be subjective and differentiated for each designer. But with characters and structural elements in common.

First of all the fact of using an indiziary paradigm, or rather a series of subsequent indiziary paradigms that will mark the evolution of the project through moments of linear development and, alternatively, moments of a jump.

The indiziary paradigm is a subjective hypothesis of an organization not only of the existing elements/requests but above all of those to come, still unknown and inscrutable. It is, therefore, a bet, a challenge.

As with all bets, for every challenge we launch, the goal is to win. In this case that of succeeding, with our organizational hypothesis, with our circumstantial paradigm, to grasp and direct possible developments, to find ourselves prepared for every future event, for every sudden increase in complexity.

But, at the same time, it is an instrument that must be used at best. When it deteriorates, when it no longer responds to the increase in demands that the project itself generates, it must be replaced without regret, and with another paradigm more relevant to the level of complexity achieved.

What is, practically, an investigative paradigm, and when and how is it to be replaced? It is a tool for controlling evolution. Each designer uses different types of investigative paradigms, even if they normally contain some geometric, topological, dimensional, hierarchical control devices and rules on the relation norm/exception. They can also contain a typological control structure, but then they become too conditioning and restrictive. The type is already a formal matrix, and if we assume the typological aspects as conditioning structural elements, in fact, the possibility of developing the idea is reduced. It is preferable to systematize the requests and use them as necessary but fluctuating and connectable elements on all sides, like the other elements/requests in play.

In practice, the control tools proper to an investigative paradigm should be limited to the control of how to proceed, how to aggregate events, how to transform possibilities and forms and not have inherent structures that already contain an organized response. All prestructured responses lead to short-circuit the process, to simplify the process. And this contraction is not, for the designer, an advantage. It risks placing him back in the swamp of equilibrium, which has already been completely resolved by hiding him, snatching from him the possibility of transforming problems into new design opportunities, of accumulating possible unused formalizations as a background of stimuli capable of catalyzing the continuation of design evolution. Let's analyze, one after the other, the possible control instruments that form a circumstantial paradigm.

### **GEOMETRIC MATRICES**

Geometry is undoubtedly one of the most effective tools. It is certainly an indication of how a complex structure grows regardless of what it should contain. And it has a further advantage: it ignores the scale, or rather, it controls the progressive passage from one scale to another, from the totality to the shape of the single components.

There are, of course, many types of geometry that can be referred to in the

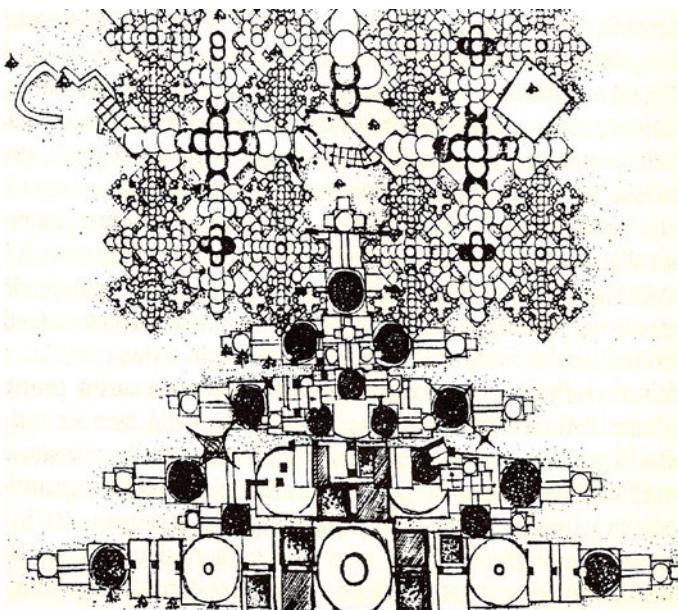
construction of a paradigm. From orthogonal plotting to fractal geometry.

The orthogonal weave is, perhaps, the most easily accessible geometry and, all in all, also one of the most advantageous possibilities. The main advantage of a control tool is to be able to control, and therefore to adapt, to unforeseen and different situations. An orthogonal geometric pattern can, unlike a sixty-degree triangular pattern, structure differences in fields from square prisms to rectangular prisms of various types and easily contain progressive slippage to other configurations. A sixty-degree plot, on the other hand, will preferably produce only prisms with an equilateral triangle as their base.

But it is not necessary, indeed it is not even desirable, that the geometric control takes place with a single geometric plot. Following the logic of approach that we have adopted so far, the most interesting tools, those that most guarantee the growth of the project, are also those that create development dynamics.

If we adopt multiple geometric, simultaneous and parallel plots, conceptually structuring the modes of transmigration from one to the other, we put ourselves in the condition of possessing not only further ways out of the unpredictable evolution of the project but also, and above all, more alternatives to choices, more receptors of the possible, thought and conceivable, wandering formalizations that form our background of reference.

*Figure 1. The reconstruction/design of a natural context through the construction of a dynamic model. The experimentation was carried out with the implementation of iterative procedures through the use of a photocopier. The formal matrices used are some basic drawn forms, while the procedures are realized through the iterated reproduction of the same forms, reduced, on the previous form. In this way, a progressive shift in scale and complexity is implemented'. In fact, through the photocopier, the same procedure of successive homothety that generates the fractal forms is realized. The image is by E. Vallania's master thesis at the Politecnico di Milano, supervisors C. Soddu and E. Colabella.*



A separate approach belongs to the use of fractal geometry which, as symmetry/homothetia, has always been used in architecture. Fractal geometry is, in fact, one of the classic tools for controlling the passage of scale, both in terms of natural forms and in terms of the architecture of every age and culture. Fractal geometry simulates and controls the how (the how is a constant of geometry) you pass from one scale to another, the procedures to follow.

If, for example, we take a shape drawn on a sheet of paper, we photocopy it with an always equal reduction factor while simultaneously rotating the sheet of paper always of the same degrees, then we place it on the first sheet and repeat the operation, we will obtain after a few steps a complex shape, almost natural but perfectly controllable. And we will have generated it with an iterative procedure of fractal type. If in parallel to all this, we decide that each square present in the indicatory paradigm can be divided according to axes at a third of the sides, so as to form two rectangles and two squares, and the resulting squares can iteratively undergo the same process, we have defined a procedure to control formalization even in states of subsequent complexity. This control, operated on the procedure of the passage of scale, is typical of both design work and fractal geometry.

It is in fact usually, in projects born at the same historical and cultural moment, or in the projects of the same architect, that the same procedures of progressive transformation of the shape are implemented in the passage from one scale to another; from the shape of the building to the design of the portal, from the capital to the geometry of the tile decoration, from the stereometry of the industrial object to the texture of the decoration.

The geometrical matrix within a control paradigm can and must have two types of value: the possibility of operating as a trigger structure between events at the same scale, orienting possible forms of interface, and that of providing modes and procedures in the passage from one scale to another, reverberating formal matrices as a possible vehicle for the increase in complexity.

## TOPOLOGICAL MATRICES

A second field in which it is appropriate to activate adequate control tools, and to include them in one's own indicatory paradigm concerns topological aspects. One possibility to activate this field is given by the possible conceptual construction of particular sequences. In practice, it is possible to identify and define the modalities of how, in the environmental space, one approaches a place/object, how one passes from one space/object to another, then to another one, etc.

The most immediate sequences on which it is possible to identify and structure possible modes of configuration are those that concatenate, in the artificial environment, the most external spaces to the most internal ones, the successive sequences of the passage from public spaces to private spaces. Sequences that can also be read, as for example in Greek temples, as a passage from the holy to the profane through sequences from light to shadow, and where the columns, with their sunlit grooves, were the interface in which light and shadow coexisted simultaneously.

This type of evolution control tool provides, with each increase in the complexity of the project, new and precise functional requirements, which require adequate responses to specific needs.

However, this is a particular functional area, which can be identified as a symbolic function.

Symbolic in that it prescinds from objective contents to direct the possible

extemporaneous subjective contents towards specific modes of development. Symbolic is, as Cassirer says, an Omni-comprehensive medium. Its specificity is therefore in line with what must be an investigative paradigm.

On the contrary, the symbolic function, being a structure of control of becoming, of possible, unpredictable subjective contents, is, in synthesis, the very material of which a paradigm is composed.

On this same level, the dimensional control tool must be considered and structured in the paradigm. The aim is not, in fact, to define dimensions, but to activate their growth modalities.

The simplest explanation of this necessity is the activation of the module, or of a modular grid. More complex can be the activation of procedures for the determination of volumetric ratios between different spaces, or the resizing, for plausible sizes, of the geometric patterns used in the previous points.

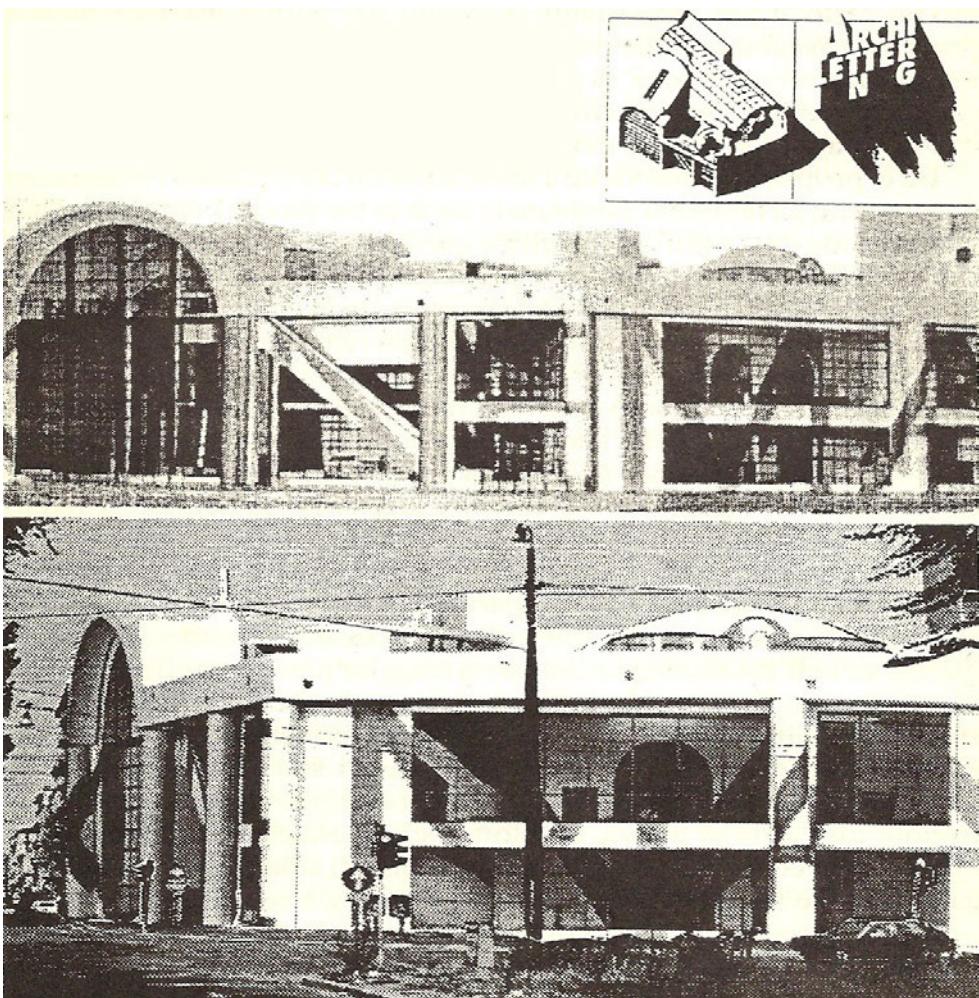
## HIERARCHY AND SIMULTANEITY

The other two areas indicated the one concerning the hierarchy and the one concerning the instruments of control of the regulation/exception ratio are, even if they do not immediately appear as the backbone of the project, those that will perhaps determine more deeply the characterization of the result, and of the same logic of approach adopted.

In the project all the elements, needs, structural and material needs, reference forms, conceptual needs, etc. are equally important. Every question that is asked, by the client but also by the project itself that evolves, must have an answer. And these answers, precisely because of the structure of the project, must be simultaneous.

This, however, can only be true in part. We operate simultaneously but, due to our subjective inclination towards certain aspects of the problem, we hierarchies (not only temporally) this overall response structure.

Anamorphosis is a possibility of multilateral reading of an architectural object. The project is a redesign in which the writing "cinema" is a shattered sign that is visible only in particular points of observation. Degree thesis by V. Piaggi, supervisors C. Soddu and E. Colabella



We can use as an element to trigger the response/form sequence (as a catalyst, this time participating in the game and not just a vehicle) an entity instead of another, the grain of a material instead of its shape, or the external image of the building instead of the internal one. Choices of hierarchy that do not compromise the simultaneous complexity of the response, but that orient the response itself, characterize it and, of this characterization, make it an element of recognizable identifiable upstream of the contingent object that will be formalized.

Therefore a first transversal, a post-metaphysical element of reading of every single possible project is born, a key of recognizability that underlies the infinite virtual stories that the designer can subjectively walkthrough.

## ORDER AND TRANSGRESSION

A further important relationship structure in the characterization of the formal logic adopted is the relationship between order and transgression. On the possibility of activating devices to control the relation norm/exception, we must make some preliminary considerations.

It is, in fact, a field that structures the order that will be present in the project, meaning by order certainly not the "regularity" of the project structure, but the organization of possible, and intersubjectively understandable, keys to interpret the project itself, and the artificial that is intended to be performed.

The order of a project is, among other things, the possibility offered to the user to immediately understand the total organization and the matrices of the increase in complexity. In architecture this leads to facilitate the understanding of the distribution structure and move inside, even for the first time, finding the indications to intuit its logic; but also simultaneously offers the user characterizing, unique and surprising elements. In the object means making accessible to subjective use the facets of meaning that have accumulated in the design history, facilitating, in the user, possible interpolations between structural sequences in order to activate an unsuspected and unpredictable use of the object itself, a pertinent response to the needs not yet expressed by the user.

This contributes, certainly, to the achievement of total quality as an extended response to possible needs; it can also become, in a different (and perhaps distorted) approach, the creation of non-existent needs in order to increase consumption.

In the environment, the order is undoubtedly the presence of recognizable references, the finding of possible and different sequences as a way of approaching places. But maybe it cannot be considered order, but only regularity, the monotonous theory of buildings all the same of some peripheries that, on the contrary, tend to cancel references, to homologate the image to any contemporary periphery, and to confuse the intuitive and immediate appreciation of the site.

In fact, we could consider everything that leads to an increase in communication to be in order, and evaluate it with the same criteria that we use to assess the amount of information in a message. In this sense, we can consider the two borderline situations the same: the extremely regular and the completely disordered one. In both cases the information that is produced is null.

Once we have defined a possible order to be inserted in the organizational paradigm, we could control the evolutionary dynamics of the project by working simultaneously on two different fronts: the increase of recognizability of the hypothesized order and the exceptions that contradict it. The increase in order can be implemented not only by reiterating and making redundant some factors but by progressively shifting from one plan of choices to another. For example, by placing unique events in geometrical nodal places with respect to the adopted plot, or by hierarchizing the increase in complexity of details along lines consonant with the activated rule.

However, bearing in mind that the drop in tension, interest, and I would even say surprise of a possible user coincides, inexorably, with drop-in information and, consequently, with a drop in order.

Exceptions are therefore necessary. Which must not always be identified as exceptional events, but as different, unexpected events. If a symmetrical structure can be appreciated it is also because it is broken in certain points because there is the possibility of discovering dissymmetries, specific characterizations of individual places.

The relationship between unique/exceptional events and repeated events is extremely

delicate and is difficult to evaluate outside of a concrete design approach. it is also a transversal value that characterizes the production of each individual architect, which makes every approach logic adopted unique.

There is, in this double field of repeated and unique, an evaluation of the choices to be made that transmits from one scale to another, also producing "out of scale". The unique element, the exception placed within a rule, makes a jump of scale by re-proposing an element to the dimension of the monument. The repeated element makes a reverse jump, referring to the sequence of subsequent events its contribution to the construction of its role in the project.

If this possible alternative becomes a device activated in the proposed indiziary paradigm, therefore an instrument of preventive control of an unforeseeable evolution, this double possibility offers considerable advantages.

The possibility to choose between regular or exceptional allows the maximum openness of the system. is an adaptive attribute of the paradigm that allows facing with more flexibility the incessant proliferation of requests and random/subjective events.

## **FROM ONE PARADIGM TO ANOTHER**

Discontinuity and logic jump

After all, the most important attribute of the indiziary paradigm is precisely flexibility. Which does not mean, it is obvious, not characterization, but, on the contrary, the ability to understand the subsequent possible and subjective characterizations, the increase in complexity that we intend to produce with the evolutionary dynamics of our project.

And it is precisely when all this is lacking when the evolution of the project has changed the cards on the table so much that the adopted organization can no longer control this increase in complexity, that it becomes necessary to change the paradigm.

When we are forced to turn everything into exceptions by crossing the threshold that we have given ourselves, when every request that comes to us from the growing complexity of the project, in order to be satisfied, needs a further distortion of our idea, then we must not remain attached to the paradigm adopted, but we must build another one.

This is what happens, on another scale, in the growth and transformation of cities. When the increase, accelerated, of demands, and therefore of complexity, can no longer be satisfied by the existing structure, we change the structure. Or rather, you reconvert the existing structure into another one while maintaining most of the existing events.

In other words, while it is obviously necessary to consider what already exists in the environment, or at least most of it as irreversible, we can, however, globally reconsider the system of relationships and the same modalities of relationship between events, placing them in a different evolutionary key. And it is in this way that the historical centers change scale, passing from an urban nucleus to an integral but redefined part of the metropolis: a sort of square, the living room of the whole city. Or the same streets, once connected, become only distributive elements and delegate their ancient role to new infrastructures, and so on.

All this can happen in the history of architecture or design. And with an undeniable advantage: the events already formalized, the choices made are not, as in cities, irremovable. They can, not only be easily moved from one context to another of the project, but they can also make jumps of scale, becoming from forms of space/object to forms of detail, or serve only as a memory capable of catalyzing, and making more complex, future choices.

But this ease of maneuvering, canceling or shifting pre-operated choices, however, makes the operation of assuming a new paradigm complex.

The risk is that much of the work done will be lost. The challenge is to use this changeing to gain direct access to a higher level of complexity, to approach the design quality sought.

We find ourselves, in fact, in a moment of discontinuity in the design evolution. Everything that exists before this moment will not be able to exist, with the same characteristics, once the jump has been made. This is also due to the fact that each element entrusts a large part of its recognizability, characterization, and ability to respond to the fact of being placed, to its context of reference. And if we, suddenly, change the context we find ourselves with an element that may have been strongly halved in its

potentiality, or deeply modified.

The goal, evidently, is to use this loss/gain sense. To find oneself with more evolved elements, which have lost their skin of detritus of categoricity and axiomaticity and have acquired the capacity to respond to possible human needs. And as if we were training our project to the unpredictable. Transmigrating from one paradigm to another we will refine the openness and flexibility of the system we have structured and, at the same time, we will make it more reliable. Training does not mean, in fact, flattening compared to an external program. It means increasing the possibilities of responding, in an always effective and relevant way, to the unpredictable.

The abandonment of linear development, to face a moment of discontinuity, has been analyzed by contemporary mathematics (with R. Thom) and the systematization of this passage is known as catastrophe theory.

While in the previous development all the choices were revocable, it was possible to make and unmake them with continuity within the adopted organizational track, or rather it was possible to operate by successive sequences of development delegating to paradigmatic control tools the overall simultaneity of the project growth, in the moment of discontinuity this cannot happen. Everything stops simultaneously for a moment, and then everything starts to evolve again on a different track.

And the choice of track to use, among the many possible choices, is not so easily reversible. However, we have the tools to evaluate the options that arise. We could adopt variations on the various control tools, for example, the geometric plot, and this is not only the most usual but also the most easily practicable.

The problem is, in fact, always to respond to the increase in complexity, to respond to an increasing number of requests. If our geometric plot was too categorical (such as a plot of hexagons which, even if fascinating theoretically, is extremely refractory to any increase in complexity), or too axiomatic (an orthogonal plot forced on dimensional ratios which turn out not to match the great mass of requests, and therefore generate an overabundance of exceptions), in these cases it will be enough to make a jump in complexity, and structure a plot capable of making "regular" a whole series of events which, in the previous hypothesis, had necessarily to be considered exceptional.

More complex but approachable in the same logic, an exhaustion of the paradigm in relation to the other instruments of control, from the topological one to the one related to the norm/exception ratio.

For example, if the structure of the sequences between possible spaces/entities, the symbolic matrices we had adopted as the main theme of our hypothesis are not able to support the development of our project, we can redefine them both by varying the sequential structure and by interchanging spaces and interfaces.

Very often, in fact, in carrying out an idea, what at first might seem to us an interface, an opportunity to formalize a passage from one space to another, becomes itself a space that requires an autonomous identity. And on the contrary.

Every variation that is made in the paradigm, however, has a recurring connotation: every new paradigm must have a greater capacity of response, must be more complex and open, must operate on a more sophisticated level.

Besides, also the elements that now wander in our universe in evolution are more sophisticated.

Every design choice we have made, every operation to transform a series of requests into a relevant form, has worked towards this goal. Every form adopted is not, in fact, a final answer to the project's requests, it is the reformulation of the request to a more sophisticated level.

If at the beginning of our design path we had few explicit requests and a subjective (and abstract) idea of the quality of the environment we wanted to propose, now these

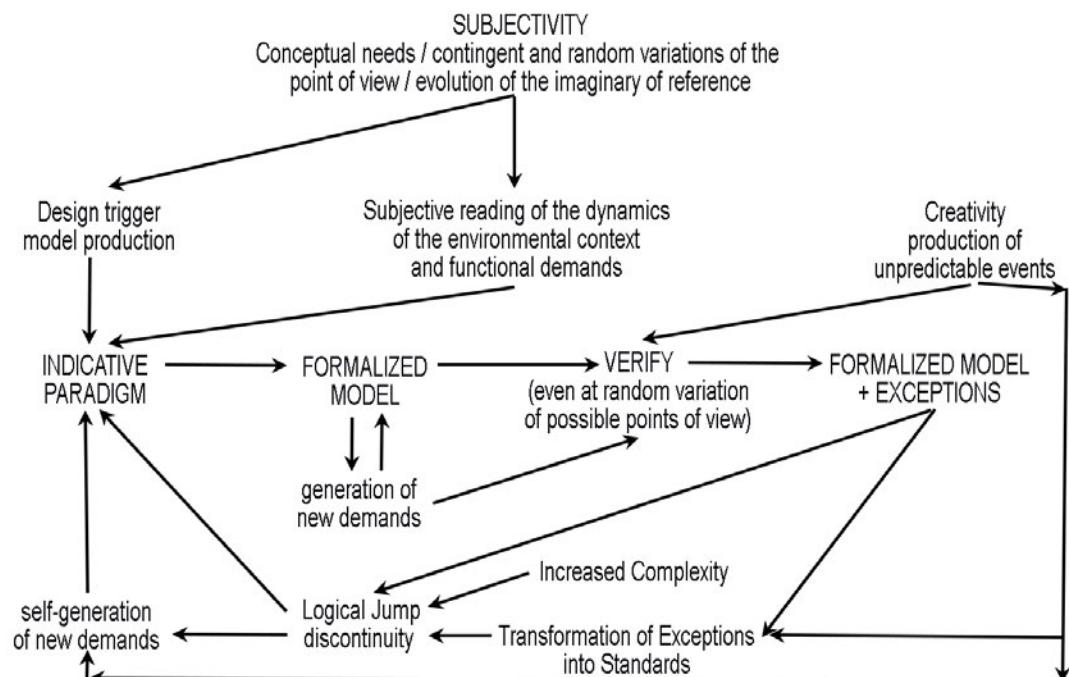
requests have multiplied, every chosen form asks questions, and we realize that these questions are more and more the operative explanation of our idea of architecture.

The universe of references, indications, and procedures that we find ourselves using in the transition from one paradigm to another is therefore much denser and strongly polarized. And it contains extremely sophisticated micro-stories.

In each of these microstories, the logical jump of this moment of discontinuity is consumed individually.

And it's a challenge between life and death. On the one hand, the abandonment of an idea, which detached from its specific context finds no place in the new order. On the other hand, the sudden, surprising acquisition of meaning that the formal choice made finds again in the new context, maintaining, even if necessarily purified, the capacity of response previously acquired.

The new paradigm is acceptable if this happens at least for a good part of the previous choices. The result of all this is similar to the natural selection of the species. The elements capable of adapting and responding to the challenges of the environment survive, the others are eliminated. And in the end, those who survive have acquired complexity but not redundancy, essentiality but not simplification, diversified response capacity but not polyfunctional flattening. And aren't these the requirements that we could subscribe to in order to define a good environment, both artificial and natural?



*Scheme. Structure of the iterative cycle of production of investigational paradigms and management of the norm-exception relationship. The cycle produces a progressive shift towards more sophisticated and less categorical requirements.*

## **EVOLUTION TOWARDS COMPLEXITY**

The passage from one paradigm to another and the related cyclical progress towards a progressive refinement of the virtual environment mark the time of design. Until the achievement of the objectives that, synthetically, can be identified in:

1. Increasing the recognizability of the designer's specific "making design".
2. Purification of the project from subjective and random axioms and categoricity.
3. Increase of complexity as openness, multi-laterality of meaning, the capacity of multiple answers to possible intersubjectivity.
4. Quality growth of the project as a decrease of the virtual/imaginary differential, and as parallel growth of the subjective imaginary of reference.

The normal evolution/exceptional evolution cycle, which is expressed in the two phases of development/verification within the model and the creation of new paradigmatic models through "logo jumps", will have to be iterated until the objectives are reached.

It is necessary to proceed without short-circuiting the evolution. The progressive increase of complexity is, simultaneously, both the yardstick to evaluate the paradigm shift and the training tool of the project to the unpredictable. It is therefore closely related to the creative capacity to produce estrangement. But it is also, in progress, what allows simultaneous access, without eluding each other, to objectives that would otherwise be unattainable: the strong recognizability of the compositional logic expressed subjectively by the designer, and a high adaptive capacity to respond in a pertinent way to the unpredictable intersubjective demands.

## EPILOGUE

*What matters is not producing but understanding. And to understand means to discern the degree of awakening to which a being has arrived, its capacity to perceive the sum of unreality that enters into every phenomenon.*

*E. M. Cioran "The deadly demiurge".*

We would never have suspected that chasing the paradigms of certainties of scientific knowledge would have met the myth.

We had abandoned it in dark corners, evidently badly guarded, after school education and ideals suspended and interrupted. We felt once again, unexpectedly, that pleasure of telling fairy tales that moved us into a dreamlike world as adults and children, faced with a hypothetical end, a suspension, made us say immediately: again.

From having walked these paths, identified and traced, a difference emerges. While for the large or medium scale project, from the environment to architecture, we identify in the abstraction of the heterogeneity of the results the "answer" in a post-metaphysical sense to the design question we have asked ourselves, at the scale of the industrial object it is the object, in its iterative differentiation, that poses itself as a post-metaphysical object.

The reason for this difference lies in the object/user/time ratio. While in the industrial object the relationship is one to one, i.e. each object corresponds to a single or multiple consumers, but identified as a single group, for the environmental object the fruition is multiple, diversified, complex. The identity of architecture is in its abstraction, that of the object in the aura of uniqueness.



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