The Morphogenetic Design as an AI system for the management of design processes through the total quality of the built-up environment.

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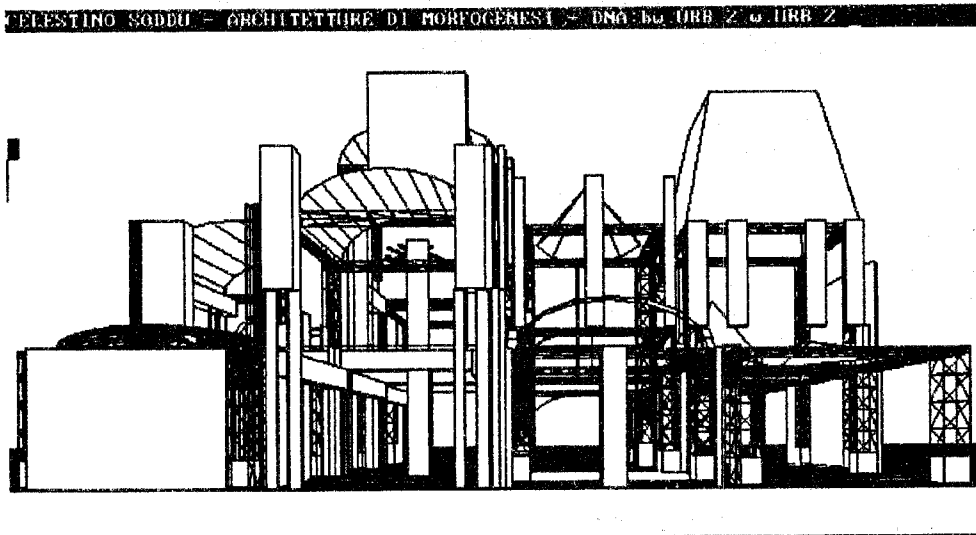theme no.2, The management of design

ABSTRACT

In our research we have experimented AI procedures in a new strategic approach to the management of design processes in buildings and built-up environment. The challenge was to evaluate, during design operations, the total quality of the future built-up environment. We measured this quality as the difference between virtual scenarios and collective imaginary world. These virtual scenarios were generated by simulation procedures of the evolution of the building/environment system related to specific logical processes of design. To achieve that we produced, using some original research software, many different scenarios of possible evolutions of the same project. Our objective was to evaluate the different contributions of each specific design function and their conflicts (from aesthetics to structural and technological problems, from cost to functional use) to obtain a more interesting logical approach to design, construction and urban environment evolution.

In this conference, we intend to present two examples of this experimentation defining not a specific solution but a possible logical approach for the management of design. And we will also try to walk in a new not-explored land of design processes that maximise the benefits of IT: the possibility of designing the evolution in the move and not only its single equilibrium. The first experimentation concerns the construction of commercial buildings using steel. The second one is a dynamic framework project to design and control the evolution and the increasing complexity of the built-up environment of a typical Italian medieval town.

Key words:
AI; evolution; (morpho)genetic design; total quality; logical approach; future scenarios

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Introduction

The management of decisional procedures in architectural and environmental design originates from the identification of the real target of this work in progress.

If the target is quality, we need to identify this quality, to measure the quality of the system we are structuring.

But we cannot easily measure quality a priori, before the end of the work. The approach to quality is a subjective approach. We can identify quality as the capacity to reply, in pertinent mode, to the plurality and multiplicity of needs of human life. It means that quality is the capacity to respond to every individual and subjective need of every user of the artificial environment we have designed. And we cannot foresee, during our design work, the whole multiplicity and complexity of possible needs.

Furthermore this complex and unpredictable multiplicity of possible needs refers not only to the use but also to the realisation and maintenance of the building.

We can measure the quality of a project design from its capacity to respond to a variety of needs that are not necessarily linked, and not necessarily identifiable before and during the design process, but that can become important in the moment of realisation or use.

We, therefore, design buildings and environmental systems that will be realised, and used, in a future time. A next future (days or weeks) is,

conceptually and operatively, the same that a future of years or centuries. The building system we design needs to answer to an approach that is different from ours; a possible different approach about use, technical and maintenance tools, and about the evaluation between costs and prestations, the hierarchic structure of needs. Every user is a different person, and his needs are, at least partially, unpredictable. And this unpredictability grows with time.

There is also another problem: we cannot evaluate quality as the addition of partial factors, because we cannot know all these factors and the complexity of relations between them. The only way we can run is to compare a virtual scenario with an imaginary wonderful environment, and to measure the difference. But to do so we need to have, at every moment of our work, the possibility of generating a scenario of the evolution of our design. Moreover to generate a lot of possible scenarios that show our designing idea in progress.

The IT utilisation allows us to work directly on the complexity and the dynamic transformation of a system without operating reductive and unacceptable simplification. With IT tools we can structure this quality evaluation as progressive control of the difference between virtual scenarios generated in real time compared with the variation and increasing complexity of the design procedures and the multiplicity of possible reference imaginary worlds simulated with a hierarchic-random approach to every different possible scenario.

To verify this possibility we have designed an original software capable of representing, during the design process, the structure of the approach we have used. Every different contribution is put inside and the working team can verify in real time the results of the possible variations of the hierarchic structure in every decision steps in front of all environmental scenarios that the tool generate.
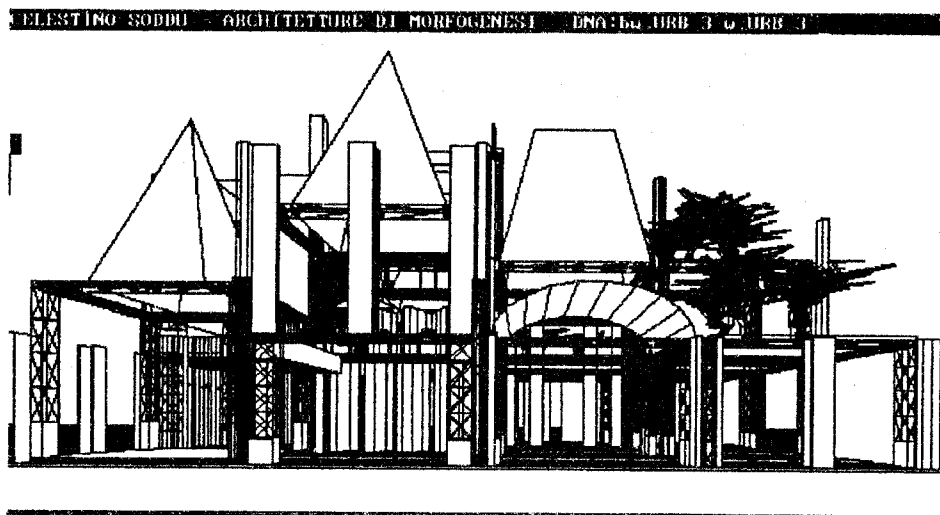
Virtual imaginary worlds and quality

To measure anything we need a standard to refer to, even if this standard is a subjective one, as in the case of quality.

But is it possible to measure the quality of a project? Perhaps it is possible but I think we never succeed in doing so by adding the capacities of the project to answer to every single request, or by using analytic procedures following sequences of cause/effect.

Theoretically, these procedures can measure quality. But in practise they are too complex and too long. It is almost impossible to run such a program especially if a pertinent answer is needed. Even if we limit our approach to the most significant sectors, often we will not be able to obtain acceptable evaluations.

It may happen that, even if every single parameter that measures a sector of the environmental quality of our project is excellent, the global quality, measured by the desirability, by the total enjoyability of the build-up environment may be in reality much poorer. We cannot accept that the total quality of a design decision may be quantified by analytic procedures, adding partial parameters. An approach to quality measurement structured through differences and not through addictions is more interesting and also more realistic and operative.

The peculiarity of men is to have the capacity of imagination. He can draw and conceive many unpredictable worlds, possible virtual worlds that are sometimes desirable or detestable. When a man is in front of a choice, he does not operate only analytically but uses his imagination. He builds mentally some possible virtual worlds, and then chooses the more enjoyable one. His choices, operated inside a design pathway, springs from this type of approach to quality. That is the humanistic approach. The final user also chooses following this approach.

It does not matter if the designer leaves out every systematic analysis. He uses this analysis a posteriori, as a verification of the congruency of his approach. The real decision is taken by the research of affinity between the project and the mental image of his virtual world.

The reference imaginary worlds are in evolution. And a good designing team needs to increase this imaginary reference world to go and reach his objective.

This approach requires two conditions. The first is the monopoly of the subjective sphere in the evaluation of quality; second is that the quality measure is strongly dependent on subjective creativity and on the resources of the designing team to configure possible worlds beyond reality.

This production of imaginary worlds need to develop dynamically. During the evolution of the project, these virtual worlds grow up, amplifies their possibilities, takes possession of each real event to operate projections for possible quality improvement.

The structure of the difference between designed world and possible worlds can measure, in that moment, the quality gained by the project. The goal is to fill the gap between the designed environment and one of the possible virtual scenarios that the same reality has built in our mind, and that appear the most desirable one.

Going back to the design process, we can define it as a sequence of choices among options of a desirable possible scenario.

The management of design needs three different opportunities: the structural possibility to choose, the presence of options and the presence of some possible desirable scenarios.

During the design process every choice is, in fact, a moment of formalisation. The options are formal options, and the choice of a formal option is conducted through the foresee of some virtual environments. Generating the grow of virtual possible worlds.

When the design make its choice, the formalised event is put inside the designing paradigm and this global environment is evaluated in reference to the possible worlds that, in the meantime, could have been improved. In other words, as the project develops gaining new shapes and new events, the virtual worlds, the thinkable worlds, gain an ever evolving structure to new and desirable possible scenarios.

In managing this evolution, this dynamic accumulation of meanings, we can get the tools to measure the correspondence between the subjective attitude and the inter-subjective imaginary worlds, shared by different individuals in order to give a measurable dimension to quality considered as a desired level of acceptability.

To manage this design process we need:

1. the possible worlds, the virtual environment we use must grow in affinity with the process of shifting between subjective and inter-subjective spheres.

It means that this dynamic evolution allows an increasing complexity, an increase of the possible use/signification, a complex answer/scenario to reach quality defined not as an objective target but as the capacity of a pertinent answer to each possible and random subjective approach. To gain the objective sphere is to gain an universe of possible subjective spheres.

2. Every design choice operated in a cycle needs/answer must be proposed again in the next cycle as a new need. With this procedure we can, during designing, achieve two targets:
A. To reach the functional plurality and the accumulation of possible subjective significations, and at the same time to purify our project from
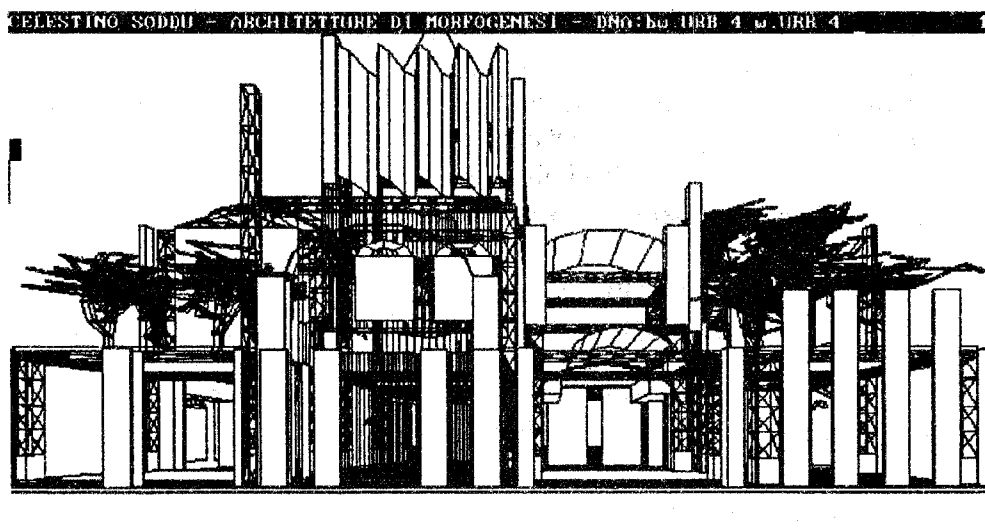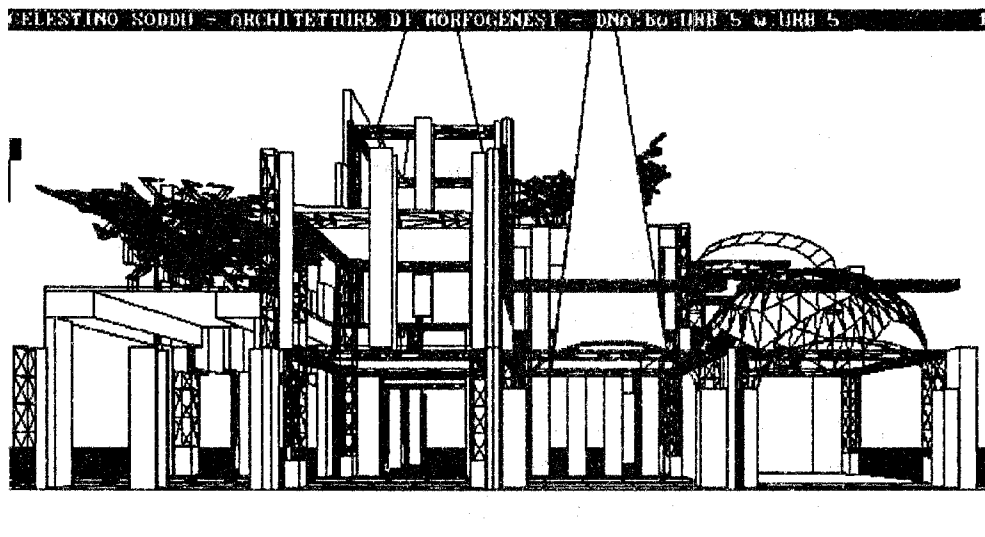
the categorical events, from events that cannot succeed in escaping from an hard subjective point of view.

B. To build a logical structure to improve design processes that also allow exceptional events, exception which are, in fact, necessary to operate the jump of paradigm to construct the multiplicity of possible virtual scenarios. But every exception, to do that, must be used as a new question in the next step of the design procedure.

3. The sequence of design cycles must draw a dynamic evolution of possible shapes, of possible architectural scenarios. This evolution is directly connected with the information capacity and complexity. The number of potential alternatives, of possible scenarios is, in fact, the measure of the resources of the designed environment to respond to the possible needs. It is not the measure of quality, but it is certainly a good key to evaluate the quality itself.
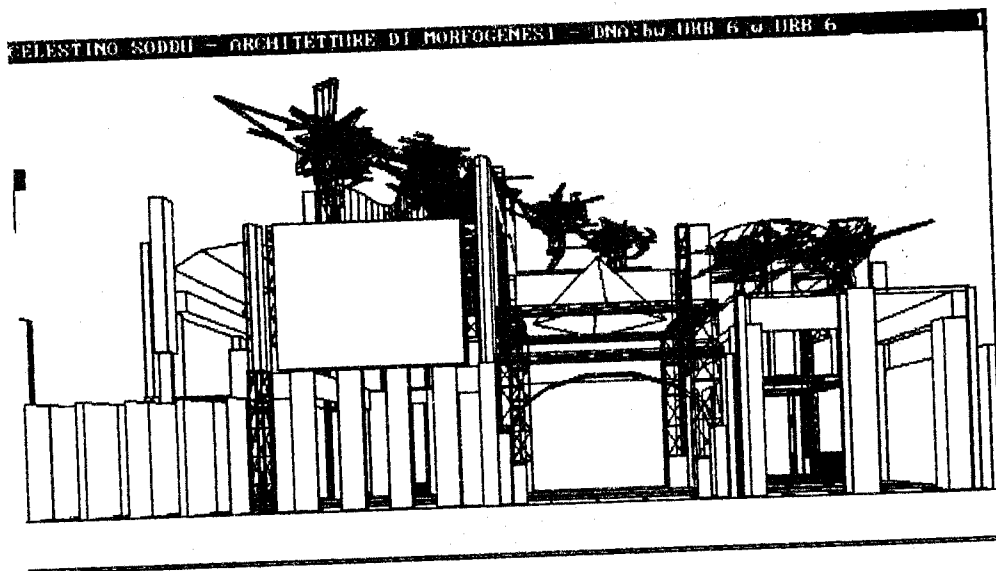

IT tools in management of design. Our project.

To control these complex procedures we can use IT tools. Using IT it is necessary, first, to increase the operative potential of representation as a control tool of design and, second, to increase, also using random procedures, the representation of possible virtual worlds. That is the progressive shifting from subjectivity to inter-subjectivity, defining inter-subjectivity as the simultaneousness of possible infinite subjectivity.

The IT tools that we have designed and realised were born to operate inside the difference between the real environment and the virtual one, inside the difference between the designed event and the desirable world. The tool can show the multiplicity of possible scenarios that every design choice can enlight. It is a device capable of generating always different

possible scenarios in front of each single composition idea, of each single design choice. These results allow us to evaluate the quality of the design process in progress.

These tools, also, give us a concrete representation of the dynamics of evolution of a "designing idea" through the continuous increasing complexity of virtual environments. In other words, the operating contributions of these tools is in the explicitness of the project evolution from the subjective sphere to the inter-subjective sphere, allowing us to evaluate the increase in quality during the designing process.
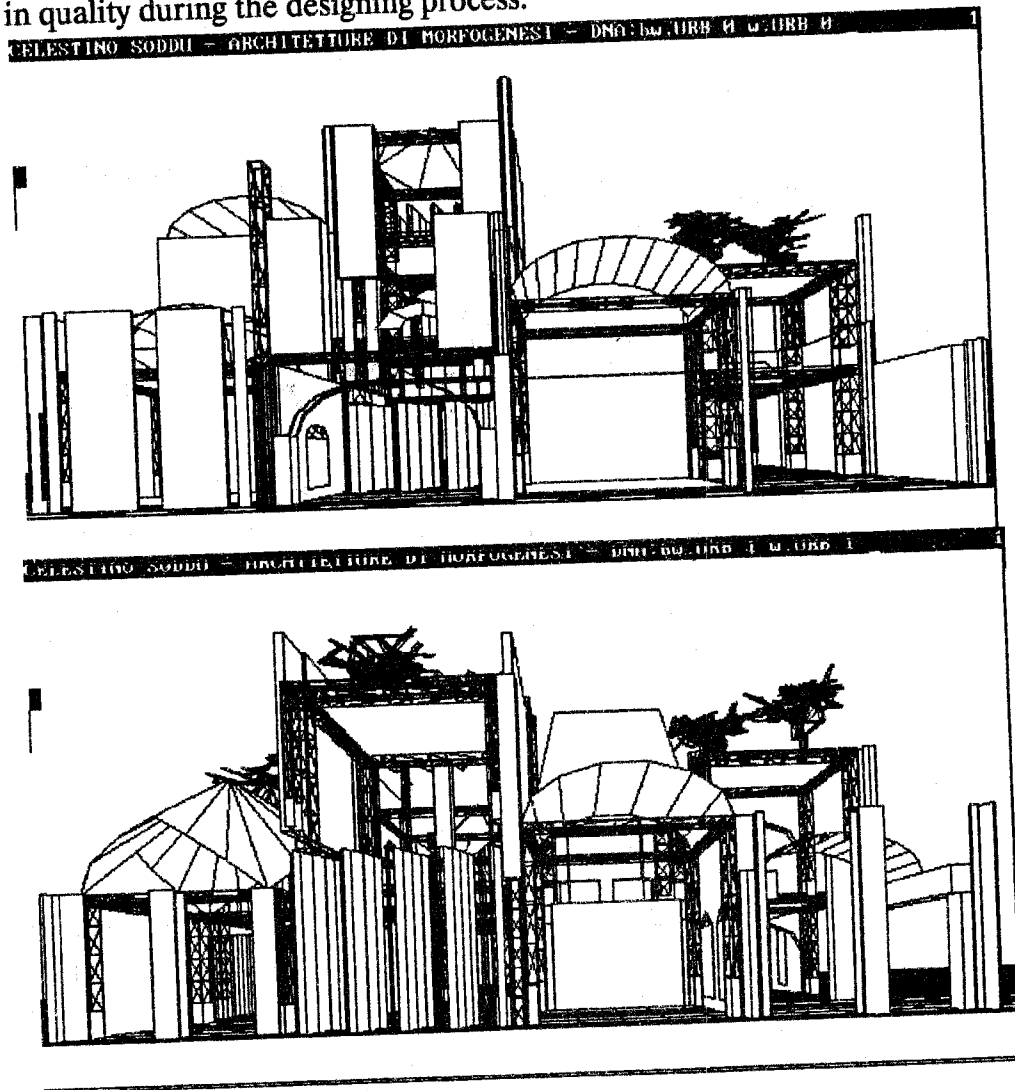
Using these tools we have made some considerations. Following the possibility, offered by these IT tools, to generate many different 3D scenarios as a projection of a single composition idea, we can consider that the multiplicity of possible shapes is not concurring with creativity. It is only a possible representation of the idea, as a logical-formal DNA, a post-

metaphysical structure of the same idea. This reflection gives a working priority to each choice operated inside the evolution logic, to the tools that allow these choices and, therefore, to the evaluation and control of the idea before its infinite possible realisations inside a shape.

Concerning the measurement of quality, the experimental research we have done allowed us to identify some elements of the design process that can exercise influence on quality. We have experimented the possibility to measure quality through some quantifiable parameters:

1. The quantity of choices operated during the design process, measured in terms of information. (That defines the way to shift from subjectivity to inter-subjectivity).

2. The consciousness of the choices operated, identified as quantity by the grade of permanence of every choice in the development, and by the possibility of recognising the previous choice as "patina" of time. It can also be evaluated by the increasing difference between different virtual scenarios generated by simulation.

3. The quantity of basic alternatives about each single choice, identifiable, with our IT tools, by the structure of the generating procedures. These algorithms are structured upon the interpolation of different devices representing the various disciplinary sectors of the decision. These devices are not a data base but they are a reference world in evolution, without limits defined in advance. In other words, these tools use a lot of simultaneous different linear systems to produce resonance, that is a dynamic non-linear system as it happens in every genetic code in nature.

4. The availability of the design approach, (and, in our tools, the simulation device of the logic approach) to accept and manage exceptional events. This point is particularly important because the relation between information capacity and exception is not linear but, in front of each system, has a different maximum. I mean that, when the information capacity of the designed environment grows in the beginning in relation to the presence of exceptional events, this trend changes following different ways in different situations. We can identify, experimentally, the position of this change in the moment that most exceptional events cannot succeed in defining a new possible stratified order, an unpredictable point of view inside of the paradigm in use.

Some other parameters have no influence on quality, and some of them may be a surprise.

1. First of all the single patterns we have choose. For the information structure of our project, the single formal operation is not important.

Although it is important that we have done it using with consciousness a high number of alternatives. To over- evaluate a single formal choice may be to destroy the increasing complexity, and therefore quality.
We can redefine the single formal choices as a catalysing event that is important to improve the process of increasing quality, but this event can be also not involved substantially. This formal choice can define the cultural reference, the style, but it does not modify global quality. But quality is related to the number of alternatives used in this act.

2. The limits we define between norms and exceptions are not important. It's important, for quality, to define these limits, and to operate a logical jump in our design process every time we find, and accept, an exceptional event.
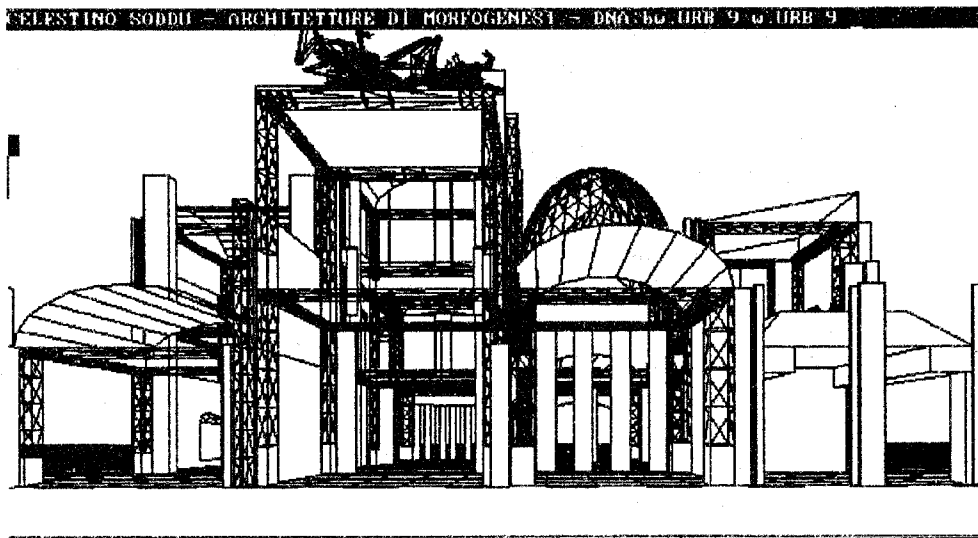
These are the first considerations done using our IT experimental tools. Our approach, performed in these IT tools, is inside the actual possibility to activate some experimentation sectors, and to use the simulation tools in some disciplines, as design processes, where the control the increasing complexity is needed.

Our research and our proposal is, therefore, also an approach to quality of the environmental shape, and offers the opportunity to evaluate this image not referring to style, to single choices or events but to the logic approach used in designing it. It refers, also, to the mastering the management of the evolution trend of the idea, to the quantity of possible scenarios we have considered and to the consciousness to operate always a choice even if no alternative seems available.

Note:
The pictures are from the software TERME, that we have developed for the management of the design procedure of a steel commercial building.

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