.. AND IF WE TAKE A BACKWARD STEP ....

Antonio Cottone - Maria Rosa Buscemi
Dipartimento di Progetto e Costruzione Edilizia dell'Università di Palermo - Viale Delle Scienze - 90128 Palermo.

In these years the researches on the computer science applied to the building have had a considerable development.
The applications concern the whole design process, from the programming to the design and from the execution control to the programmed maintenance with a great deal of problems solved using expert systems.
It doesn't seem that the same care of men and means has been dedicated to the architectural design theory, to its deep roots which motivate it and to its peculiarity in comparison with other fields in which now the design, with the aid of the computer, is the only one possible.
The designer of architectural objects has been always helped by design assistants: it is enough to think that the sixteenth century treatises are a group of rules, descriptions, solutions to design problems and that they represent the "knowledge" of the age.
As the knowledge increased those treatises amplified to the encyclopaedic dimensions of the nineteenth-century handbooks and of those of the first years of this century, while new professional figures rose, the teaching developed and the building art became more and more complex.
With the coming of the modern movement, the past and the history are rejected, new ways are looked for, manifests which list new rules and "points" are elaborated, the history and the styles are replaced by the study of minor arts and the social analysis. Instead of studying monuments, suitable solutions and important services are required for the economic house.
The attention is directed to the large number and industrialisation which, as well as in the mechanical industry, would have lowered the costs of the "machine à habiter".
It is In this cultural climate that A. Klein publishes his studies on the evaluation of design plans which can be considered the forerunners of the studies on the systematic design of thirty years later.
In fact, it is about in the sixties that there are a series of researches and studies which try to face design problems in a systematic way and with the aid of the computer, which began spreading in other fields.
Among different contributions, some personalities such as Jones and Alexander focus their work on the architectural design, searching a more suitable approach to represent complex design problems with the aid of non-numerical mathematical instruments.
In particular, Alexander has lived for about twenty years the problem of having at his disposition a very powerful instrument to solve a complex problem without being able to obtain valuable and better results than people who haven't got these instruments.

He understands that the design isn't an optimalization and that a complex problem can be solved subdividing it into subproblems. However, he realises that in this simplification something important is lost; he composes a wide inventory of problems and respective solutions but finally leaves everything to land to the bucolic "Linz Cafè" which is to him, of Austrian origin, almost a return to the childhood.
Then, we think that it is useful to take a backward step because of the discouraging results about the improvement of the architectural quality in spite of the extraordinary potentiality of the available instruments.
It is necessary to understand a theme discussed in Italy in the seventies, namely if we are able to analyse the process which brings a certain designer to a given plan, if we are able to train an assistant for the architectural design and if it is possible to teach to plan; in conclusion if we are able to describe and to communicate everything which leads us cyclically from the formulation of a design problem to its solution.

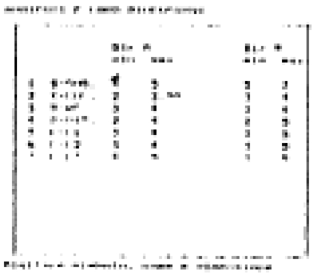
...And if we take a backward step... and organize a workshop in which rightly famed architects explain to experts of knowledge engineering their way of designing, theories, knowledges, starting points, feedbacks, and checkings on the way that generate them, the customer's influence, the visions and spontaneous or voluntary elements of irrationality. And if a group of computer scientists studied the possibility of translating these experiences in terms of existing or new languages and/or of specialised machines, perhaps we would realise that instead of trying to reach the moon with the fastest train available we had to wait the invention of the space ship.
In the meantime, we can make use of modern available computer instruments as instruments which solve little problems and which rid us of long repeating works and increase our knowledge of problems.
We could think of the realisation of big data banks of the whole present production of building elements and components, of great number of architectural design plans, of a generalised description of the territory and the carrying-out of a series of interfacing programs of technical and economical checkings. In this way, the planner becomes a director who can verify at once any design idea.
As a banal exemplification, a little program for the generation of groups of layouts of dwelling units is shown. Starting from the adjacency requirements of a layout and using the planar graphs theory and some Israelian researches method, it offers the output in a very powerful software as AUTOCAD for the subsequent elaborations.

The program runs under MS-DOS. The process originates both from the studies on design methodologies in the first sixties and from the more recent studies on the application of the graphs' theory to the building design by using the method implemented by I. Roth, R. Hashimshony e A. Wachman to solve a problem of building design.

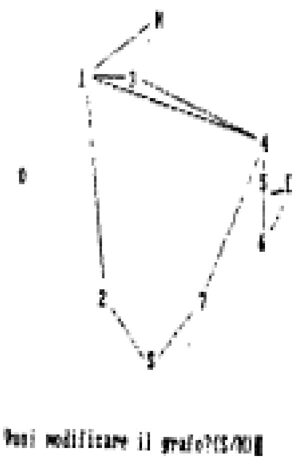
This method is applied to the design plans composed of rectangular rooms and external walls not necessarily collinear.
The first step consists in the formulation of the choices concerning the adjacency requirements among rooms, like, for example, a common wall between two rooms, and minimum and maximum dimensions in two orthogonal directions. Everytime these limits are suggested by functional, economical and legislative requirements.
Adjacency relations are displayed on a graph whose vertices represent the rooms and whose arches the only required relations.
It is necessary the graph to be planar in order to represent a dwelling unit on the layout. To this purpose, the checking of such property proceeds with a suitable implemented process. If the adjacency graph is not planar it is changed into a planar graph carrying out some modifications in adjacency requirements that is to say adding vertices instead of intersections among graph arches or suppressing arches in the initial graph.
After verifying the planarity condition, the graph is changed into another one by adding some arches in such as to obtain all external faces consisted of three or four arches. So doing, it avoids having more than four rooms with a common arch.
Every different addition of arches corresponds to a different design choice.
In the following stage, the resulting graph is 'split' into two sub-graphs, one for each direction defined previously.
A further step, forward consists in translating, through a 'cutting' process, the two starting sub-graphs into two dimensioning sub-graphs whose vertices now represent the walls which delimit rooms and whose arches represent the distance among walls.
The dimensioning graph is used to determine the dimension of rooms in the desired layout.
Therefore, with the aid of CPM type algorithm, critical rooms sequences in the two orthogonal directions are identified. The lengths of critical rooms sequences indicate univocally the minimum depth that the dwelling unit must have in the two directions, so obtaining a solution considering all the dimensional characteristics.
Computing the displacements of critical rooms sequences, it is possible to obtain a great number of layouts whose rooms have different dimensions.
Choosing the same data input as a starting point, the possibility of obtaining a large number of different design plans is connected with the possibility of different choices during the stage of graph processing and precisely:
1 - The different way of adding the further arches which are necessary in the graph for the process of representation;
2 - The different ways of drawing the graph;
3 - The free choice of fixing the dimensions of arches not on a critical rooms sequence.
4 - The interchange of the directions in the dimensioning graph.

The last stage of the program consists in transferring the diagram of the layouts, obtained through the above mentioned method, into AUTOCAD using to this end an AUTOLISP language of which the program is provided in its more recent versions.
Therefore, it represents the starting point for future developments and a moment of verification so giving the possibility of rejecting the particular choices which initially could seem the more suitable to the solution of the design problem and of carrying out other choices to obtain a more functional solution.
Working with AUTOCAD, it is possible to modify the resulting layout to go further with the design creating, for example, dimensioned plans, prospects, axonometries and a large number of drawings. So making, a real AUTOCAD library which can be used in other design moments is created and is linked with programs, through other modulis, for further verifications, so going back to some preceding stages if the product doesn't satisfy us.
The program is subdivided into the following stages:

- ROOM ANALYSIS.
Input of adjacency requirements and of maximum and minimum dimensions.

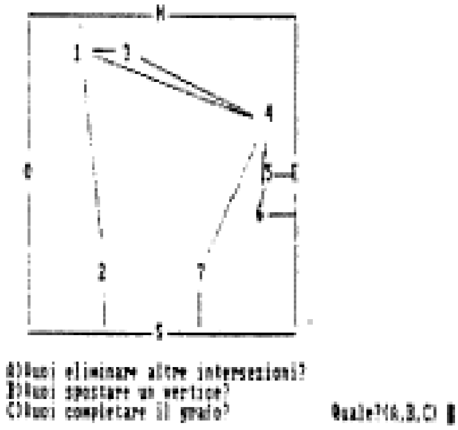


- ADJACENCY GRAPH DRAWING.
Graph drawing which represents rooms and their relations.

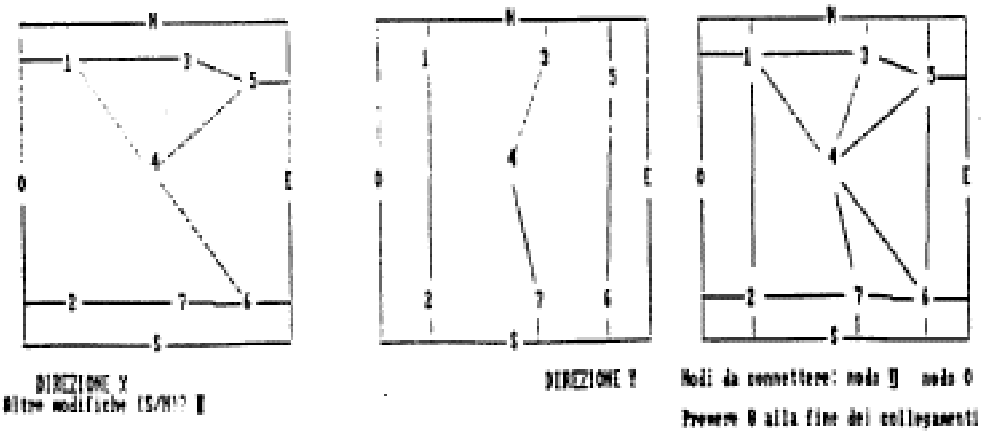


- PLANARITY VERIFICATION AND EVENTUAL GRAPH MODIFICATION.
To verify the planimetric compatibility of requirements and in case to carry out the required modifications.

- GRAPH COMPLETION.
The missing connections among vertices are added so as to obtain faces with three or four arches.

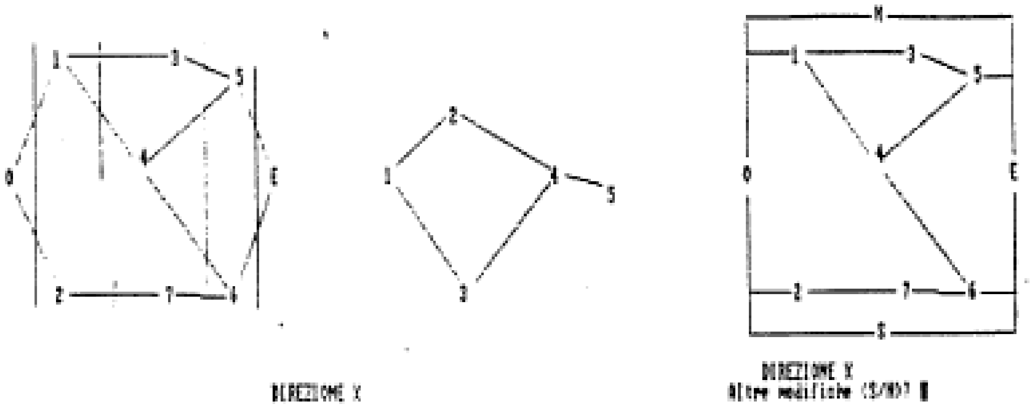


- SUBDIVISION INTO SUB-GRAPHS.
The sub-graphs are traced in the some time on the display in two orthogonal directions and the suitable disconnections are carried out.



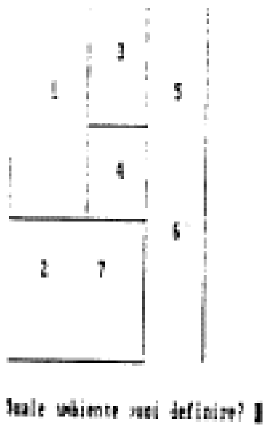
- SEARCH OF OUTLINES.

The cuts that represent the walls, which rooms have in common, are searched in two directions so obtaining the dimensioning subgraphs.



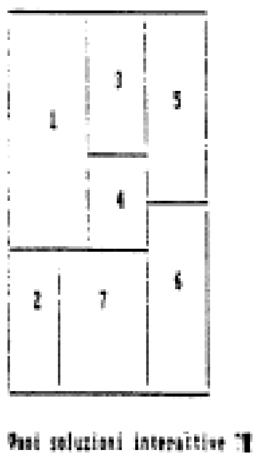
- **SEARCH OF CRITICAL ROOMS SEQUENCES IN THE TWO DIRECTIONS.**

In both directions, critical rooms sequences and the displacements of the walls, which aren't positioned along the critical rooms, are identified.

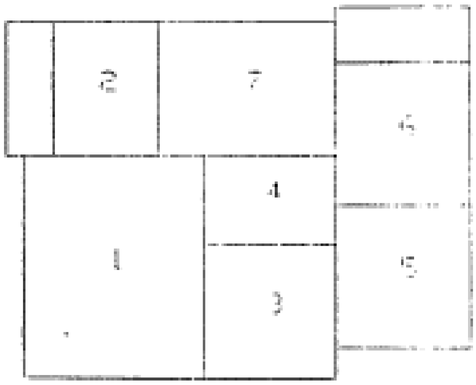


- **DRAWING OF A SERIES OF IRON-WIRE LAYOUTS.**

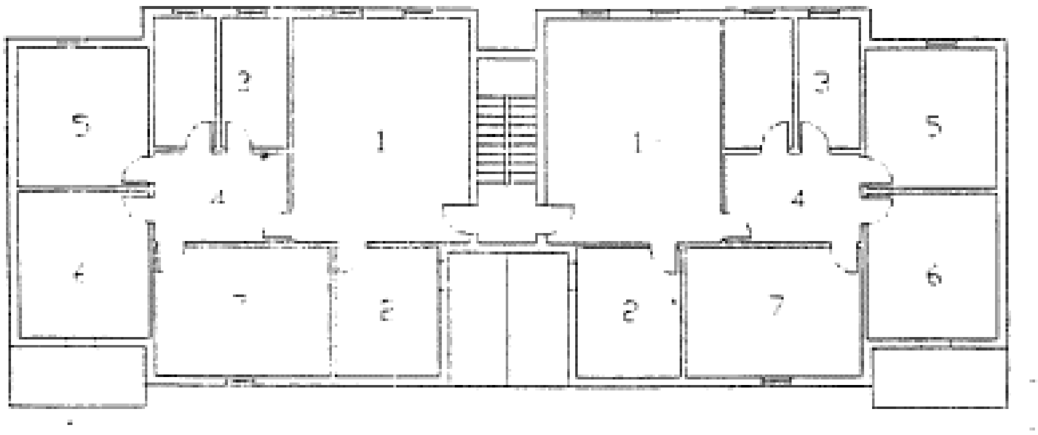
Walls are shifted in the range of the possible displacements obtaining a series of iron-wire layouts.

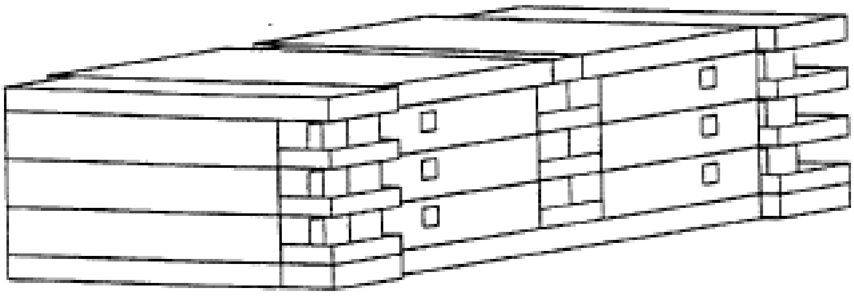


- TRANSLATION OF THE VARIOUS LAYOUTS INTO AUTOCAD.
The obtained layouts are translated into AUTOCAD by an AUTOLISP program.



- DESIGN ASSISTED BY AUTOCAD.





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