Transactions on Information and Communications Technologies vol 5, © 1993 WIT Press, www.witpress.com, ISSN 1743-3517

Invited Paper

Computer animation procedure with rendering techniques using low cost personal computers

A.F. Montagu

CAO Center, Faculty of Architecture, Design & Urbanism, University of Buenos Aires, R. Argentina

ABSTRACT

This paper discusses the advantages and limitations of existing software for video-animation procedures from the architects' and urban designers' point of view, considering how they conceive "morphological space".

One of the main advantages of using animation techniques is the simulation of the "space-time continuum" concept during the design process. For the first time in history, it has become possible to overcome the Renaissance concept of a view from a single point representing a static space.

Rendering and animation techniques also allow the simulation of textures, light and environmental conditions such as: natural lighting, shadows, transparency, fog, etc.

Most of the existing software is designed for multipurpose applications that respond to the demands of advertising, TV, video and films, particularly for creating special effects. The way that the "space" is built up in this type of applications can be considered as "hyper-realistic" and there is no connection with the ways in which the "urban-architectural space" was conceived in the past.

Therefore the main objective of this study is to develop a conceptual model that includes the constrains, the variables and parameters of the "design process" and introduce the power of "geometrical spatial generation" which is embedded in most of the video-animation and rendering techniques.

The paper includes some examples of architectural and urban visualizations, accompanied by a VHS video.

INTRODUCTION

The conception of urban-architectural space in different periods of history was related to the way of perceiving the outside world, and the methods by which this perception was represented through plans and drawings.
For the Renaissance master architects, architecture was thought of in terms of "three dimensional models" using drawing more as a conception mechanism than a technical description.

A.Palladio,1570[1]and L.B.Alberti,1550[2]systematized the architectural thinking process and geometric representation of space mainly using mathematical proportions as a design method[3] Fig. 1. The Renaissance urban space was also organized starting from a geometric conception based on focal points that derived from the laws of perspective, Fig. 2.

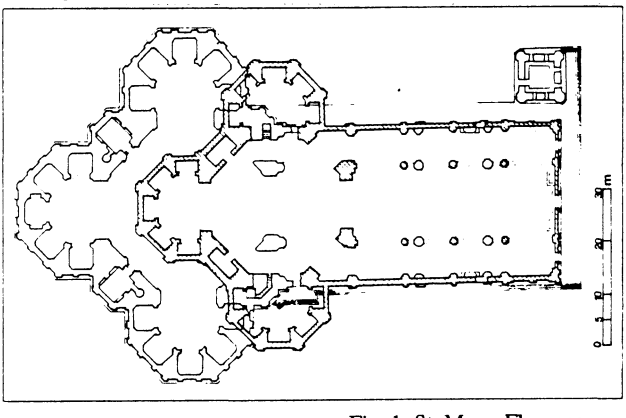


Fig. 1: St. Mary, Florence.

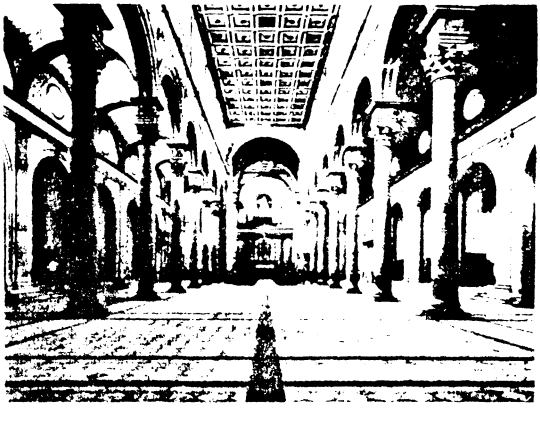


Fig. 2: St. Lorenz, Florence.

From this approach, it is possible to define a conceptual model as can be seen in Fig. 3 where the regularity of the relationship between components can be observed.

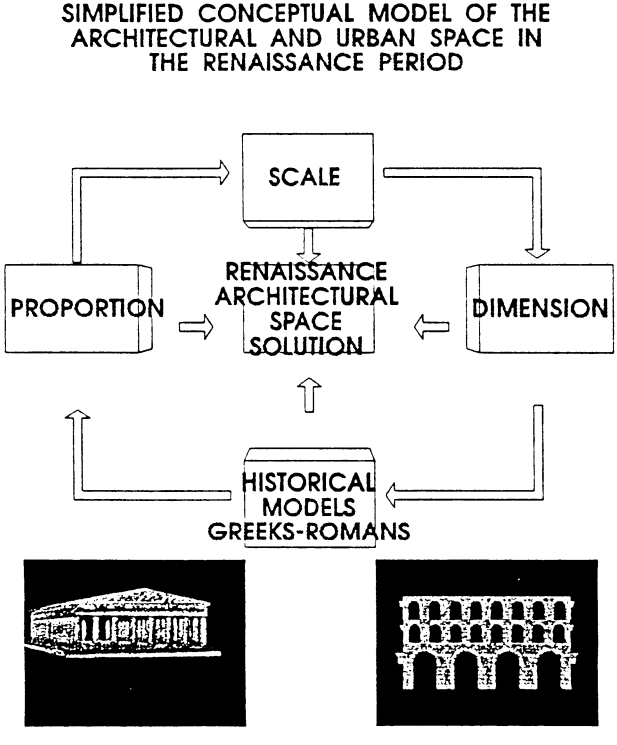


Fig. 3: Conceptual Model of the Space in the Renaissance Period.

The "Urban-Architecture Space" in the modern age has assumed a completely different character due to the influence of the "cubist movement" on the spatial concept of "modern architecture". The master works of Swiss-French architect Le Corbusier [6] Fig. 4, produced the turning point in terms of architectural evolution which also affected ideas about the urban environment.

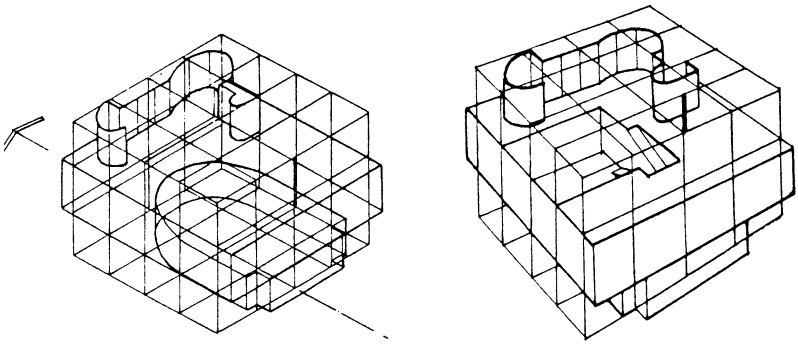


Fig. 4: Ville Savoie by Le Corbusier.

The "cubist movement" in painting and sculpture introduced the concept of "multiple perception" of reality which gave a totally different vision of the world.
This concept blends with the idea of space-time continuum which allows us to think of the "architectural space" as a "walk-through" experience rather than a view from a fixed point.

The "modern movement" in architecture completely changed the way to conceive "space" as a consequence of new functional requirements and a different design process. Fig. 5 shows a simplified conceptual model of the development of the "spatial organization" in modern architecture.

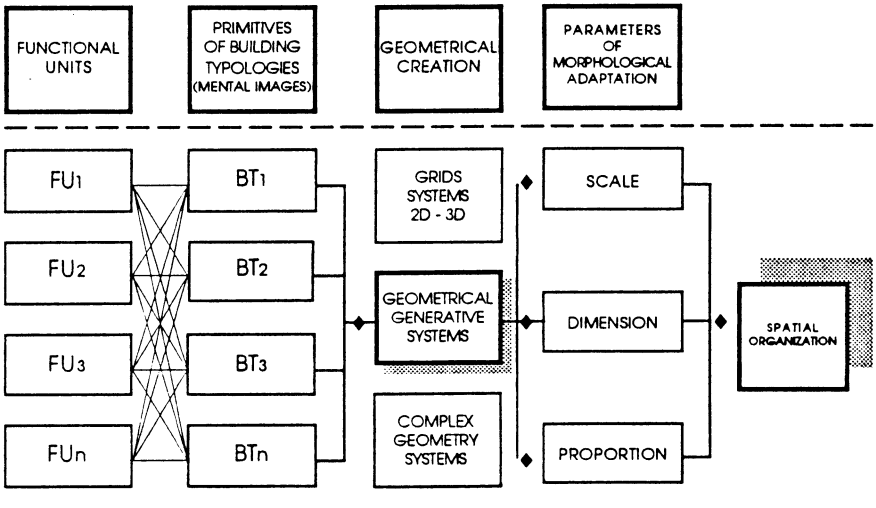


Fig. 5: Model of Spatial Organization in Modern Architecture.

Transactions on Information and Communications Technologies vol 5, © 1993 WIT Press, www.witpress.com, ISSN 1743-3517

DESIGN PROCESS AND MENTAL IMAGES

The design process movement lead by Alexander [4], Jones [5] and Archer [6] started in the sixties and has been highlighted again in the seventies and eighties with the advent of CAD languages using personal computers platforms, Moreyra, Ferrante, B. Videla & Montagu [7].

Design Process Methods were based in a kind of hierarchical decomposition of design problems in order to obtain partial solutions at each stage of the process. The process could be linear or non linear, but nevertheless the final results (architectural and urban forms or industrial design products) were not much different from those designed by traditional methods.
There is a gap between the functional requirements (the program) and the first sketches of the design idea (the solution) that, from the point of view of the designer, cannot be resolved by abstract methods as the designer is always thinking in terms of "mental images" like geometrical solutions for "building typologies" or "urban schemes".

These "mental images" can be numerical in a CAD environment showing the way to introduce this possibility at the beginning of the design process. As Porada and M. Porada [8] state: "Our hypothesis is that the numerical image can, under certain conditions, be used to express this core of information and to visualize the mental image of the future project as well as its representation, by means of intermediate representations which are some kinds of part shots".
Porada and Porada [op. cit.] also introduce the concept of "Infographical Work as the field of creation of numerical computer images born from three dimensional infographical models (mathematical and computer models). To summarize an infographical work is at the same time a sculpture, an image, a film and a written text".

The possibility to introduce render and animated images at the beginning of the design process, during the sketch design stage, gives a new tool for architects and designers not only in the sense of solid modelling with textures and varying lighting conditions but also as new mechanisms for geometrical creation.

DESIGN PROCESS WITH RENDERING AND ANIMATION PROCEDURES

The simulation of "space" in the urban and architectural environment was always the fundamental question from the point of view of "conception and creativity" during the design process.

The introduction of CAD procedures in the eighties and the extensive diffusion of these techniques during the decade has proved that without a proper design method embedded in the CAD environment, most of the designers are using these as drawing tools.

Transactions on Information and Communications Technologies vol 5, © 1993 WIT Press, www.witpress.com, ISSN 1743-3517

The three dimensional models, rendering and animation procedures of that time were to dull to compete with hand rendering techniques. At the end of the 80's, several programs for three dimensional modelling were developed for low cost PCs that completely changed the attitude of architects and designers.

For the first time, the simulation of textures (building materials) and physical environmental conditions is possible, to represent light (natural and artificial), shadows, reflectivity, transparency, fog and also all components of the outdoor environment such as: sky, green areas, waterpools, etc. It is also possible to simulate the indoor environment including: furniture, lighting conditions, etc.. Using "mapping textures", it is also feasible to simulate pictures.

This type of "reality" provides the architect with a very important simulation tool, that together with the "animation" procedure will allow the concept of "motion" to be incorporated for the first time in a three dimensional model.

This concept of motion gives the possibility to simulate the "walk-through, around or inside" the building or the city, given the concept of "space-time continuum" a real and "procedural-representational value" during the design process.

This procedural value has been determined after cheking two modelling systems: StrataVision 3d [9] and Topas [10] during the design process of a real scheme, obtaining very important feedback results from the designers and also selecting those attributes of these modelling systems that are most usefull during the design process.

Finally another advantage of these modelling systems is the relationship established with the standard format of most of the CAD files such as: DXF, IGES-DXF, TGA, GIF, etc., which reduce the problems of compatibility betwee PCs platforms.

DESIGN METHODS, CAD TECHNIQUES AND MODELLING SYSTEMS APPLIED

In the field of architecture and urban design, there should be a direct relation between design methods, CAD languages and modelling systems, since they are connected through the "creative strategy" developed by the project leader. This leader should have the ability to organize the coordinated participation of all specialists in the design team, Trum and Bax [11].

When this strategy is applied, it can be recognized as a "heuristic approach" in relation with the design methods used in the project. Fig.6 shows a simplified diagram of the relationship between design methods, CAD systems and 3D modelling systems which were applied in a rather complex urban project: the rehabilitation of the old Buenos Aires harbour.

The diagram shows the path that has been used through the design process and the principal nodes where feedback loops indicate the appearance of several design problems as a result of the sketches obtained using 3D modelling techniques.

The paper includes some prints obtained using the "Stratavision Modelling System" files; there is also a VHS Video with images produced with the "Topas System" as a complementary view of design information. In practice, architects and designers were reluctant to use video systems due to the low resolution of video images compared with those of high resolution prints and on-line slides.

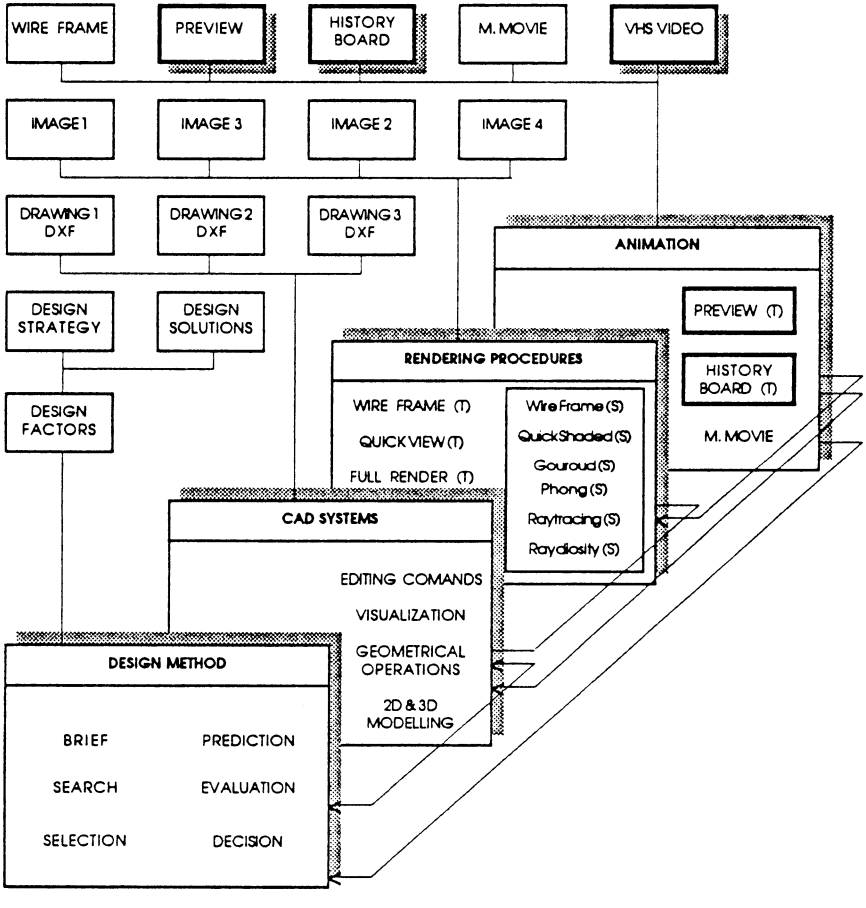


Fig. 6: Diagram of Design Methods, CAD Systems & 3D Modelling Software Applied.

Transactions on Information and Communications Technologies vol 5, © 1993 WIT Press, www.witpress.com, ISSN 1743-3517

The design process is not linear but in this case it can be summarized as follows:
a) At the beginning there is a design method approach, a "CAD group" and a "design by hand group" working together with somebody who acts as an "interface designer" between both groups.
b) Regarding the basic geometric planning information, the first CAD file was set up using the "Autocad System"[12]. The CAD file was translated into an interface format such as a DXF file which allows it to be processed with other 3D modelling systems.
c) This type of complex schemes always starts with several "mental image" solutions produced by the design group; these solutions are tested against a set of planning, architecture and environmental conditions, some of these conditions, such as: different lighting hours, high sun penetration, texture materials, pools of water, etc. can be simulated using certain rendering algorithms for: wire frame, quick shaded, flat shaded, gouraud, phong, raytracing and raydiosity [13] as can be observed in Fig. 7.
Figs. 8, 9, 10, 11, show several render examples of the same project. These examples are taking into consideration for the "walk through" approach as will be observed in the video.

CONCLUSION

The ideas and images that have been showed in this paper are the starting point for further developments in the field of design methods using CAD and rendering technics.
As it happens in most CAD systems about the possibilities of customization in order to exploit its real potentialities, we are also looking for the optimization of various render and animation systems to be used in the architectural and urban design environment.
Regarding our experience as "interface designer" and looking the architects reactions meanwhile they were developing the project, we believe that it is necessary to define a dynamic design method, open enough, in order to cover all the alternatives that occur during the process.

ACKNOWLEDGEMENT

I thank deeply to the master of argentinians architects Mr. Clorindo Testa who allows me to present in VIDEA 93 his design ideas about the renewall of the old harbour of Buenos Aires, competition award.
I would like to thanks Mr. Cristian Adamo, a young architectural student, who produced the printed images of this paper using the Stratavision system.
I also wish to thank Mr. Juan P. Cieri, Oscar Galdamez and Fabrizio Lazzazera, who prepared the VHS video using the Topas system.
I would like to mention Mrs Dora Castaneda and Mrs Laura Rivkind who worked actively during the design process producing the Autocad files.

Transactions on Information and Communications Technologies vol 5, © 1993 WIT Press, www.witpress.com, ISSN 1743-3517

BIBLIOGRAPHY

1. Palladio, A. "I Quattro Libri dell'Architettura" Venezia 1570, in Storia dell' Architettura del Rinascimento, Electra Editore, Milan 1978.

2. Alberti, L.B. "De re Aedificatoria" 1550, op. cit.

3. Baker, G.H. "Le Corbusier Analisis de la Forma", Gustavo Gili, Barcelona 1985.

4. Alexander, C. "Notes on the Synthesis of Form", Harvard University Press, Cambridge, Mass, 1964.

5. Jones, J.C. "A Method of Systematic Design" in Conference on Design Methods, Pergamon, Oxford 1963.

6. Archer, B. "Systematic Method for Designers" in Design, London 1963.

7. Ferrante, A.J., Moreira, L.F., B. Videla, J.M. and Montagu, A. "Computer Graphics for Engineers and Architects", Elsevier & Computational Mechanics Publications, Southampton-Boston, 1991.

8. Porada, S. and Porada, M. "Numerical Images, Mental Image and the Modern Architecture Triad", paper presented at the conference on Design & Decision Support Systems in Architecture & Urban Planning, Eindhoven University of Technology, Eindhoven, 1992.

9. Strata Inc. "Stratavision 3d" R 2.0 modelling system, users manual, 1991.

10. AT & T "Topas" modelling system, reference manual, 1992.

11. Bax T. and Trum, H. "The Concepts of Architecture", paper presented at the conference on Design & Decision Support System in Architecture & Urban Planning, Eindhoven University of Technology, Eindhoven, 1992.

12. Autodesk, "Autocad R 10", users manual, 1991.

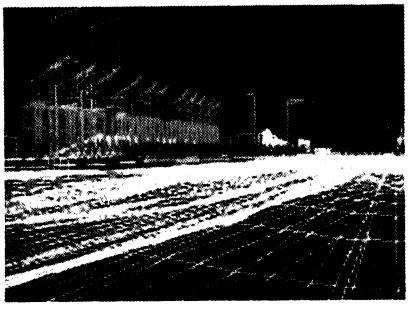
13. Strata Inc. Rendering Algorithms of the Stratavision modelling system, 1991.

ADDITIONAL BIBLIOGRAPHY

14. Krier, R. "Urban Space", Academy Editions, London 1979.

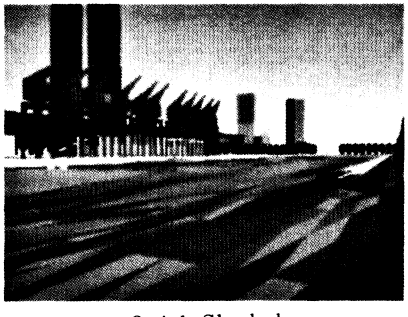
15. Salmon, R. and Slater, M. "Computer Graphics, systems & concepts", Addison-Wesley, Wokingham, GB, 1987.

16. McCullogh, M., Mitchell, W.J. and Purcell, P. edit. "The Electronic Design Studio: Architectural Knowledge and Media in the Computer Era", MIT Press, Mass., 1990.

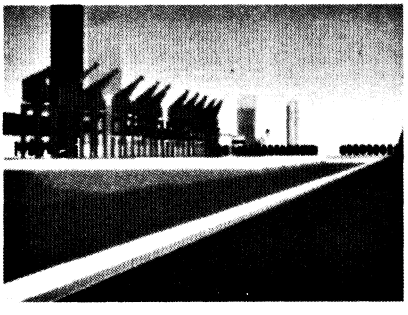


Wire Frame

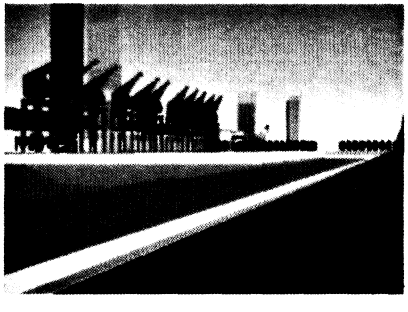
Fig 7: View of the Harbour Using Rendering Algorithms



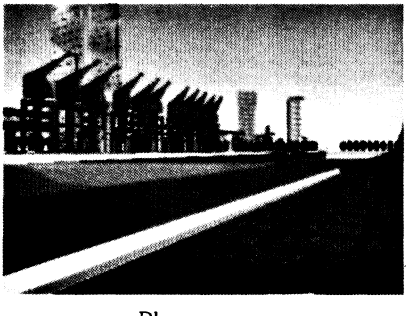
Quick Shaded



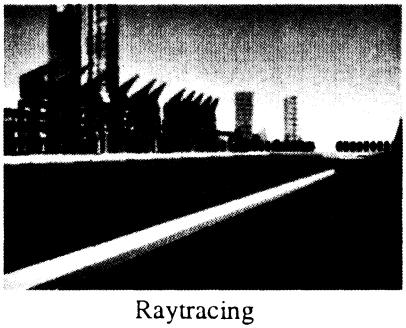
Flat Shaded



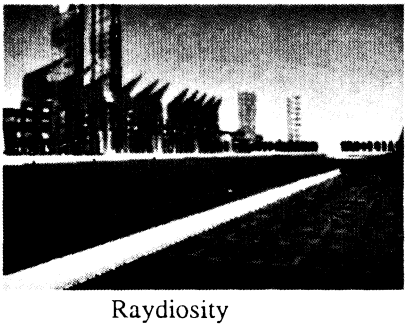
Gouraud



Phong



Raytracing



Raydiosity

Transactions on Information and Communications Technologies vol 5, © 1993 WIT Press, www.witpress.com, ISSN 1743-3517

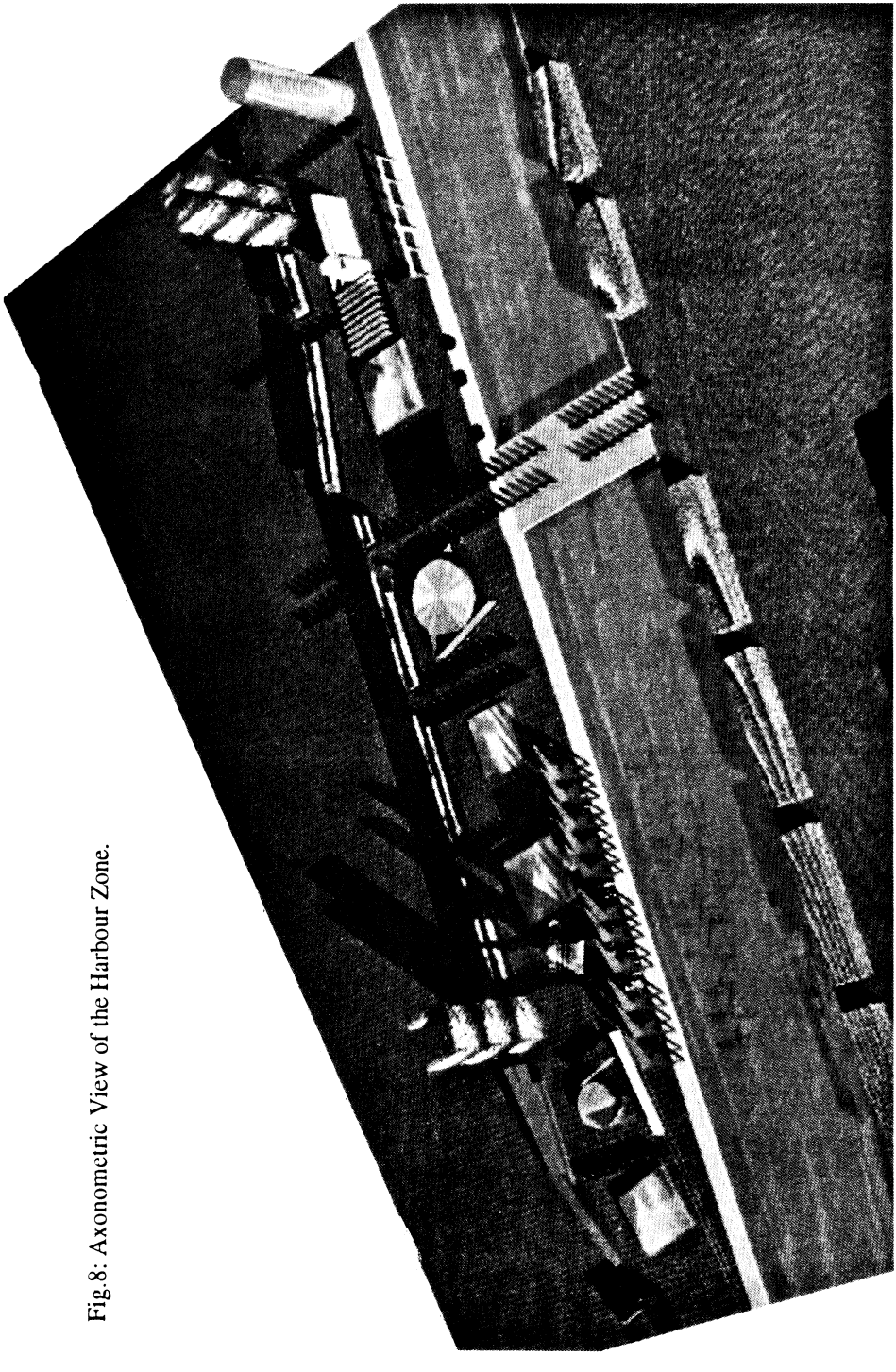


Fig.8: Axonometric View of the Harbour Zone.

Transactions on Information and Communications Technologies vol 5, © 1993 WIT Press, www.witpress.com, ISSN 1743-3517

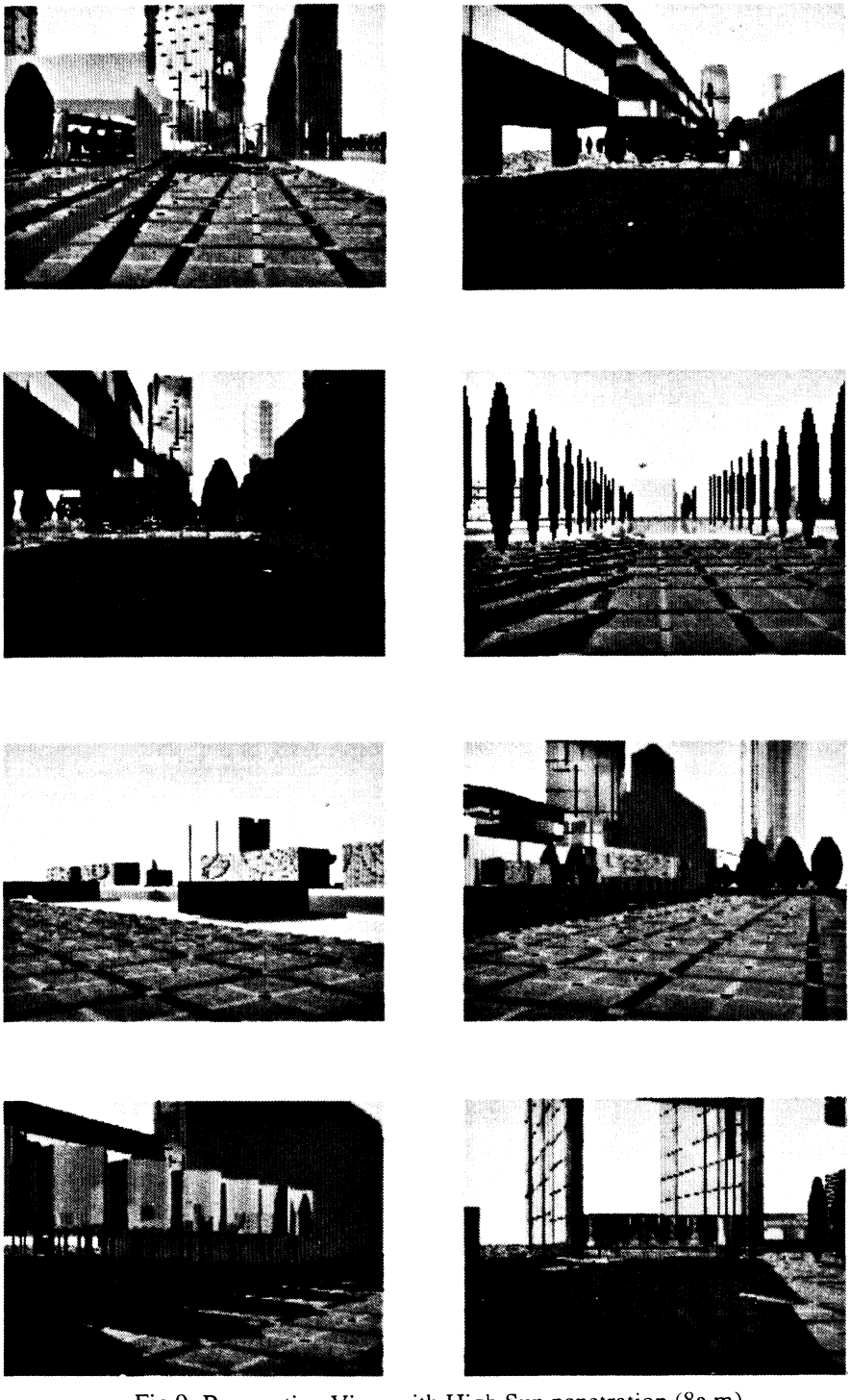


Fig.9: Perspective View with High Sun penetration (8a.m).

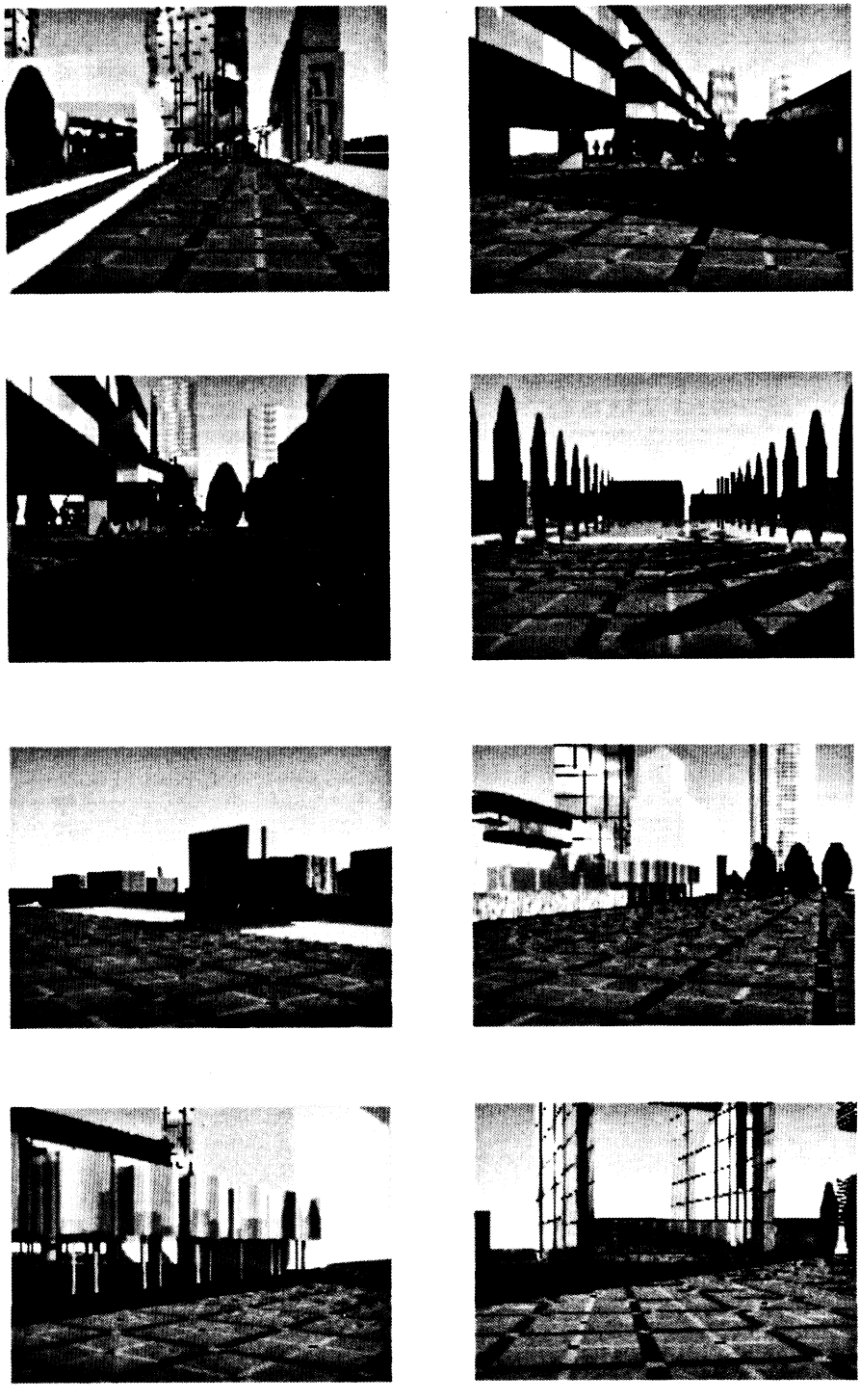


Fig.10: Perspective View with Sun penetration (6p.m).

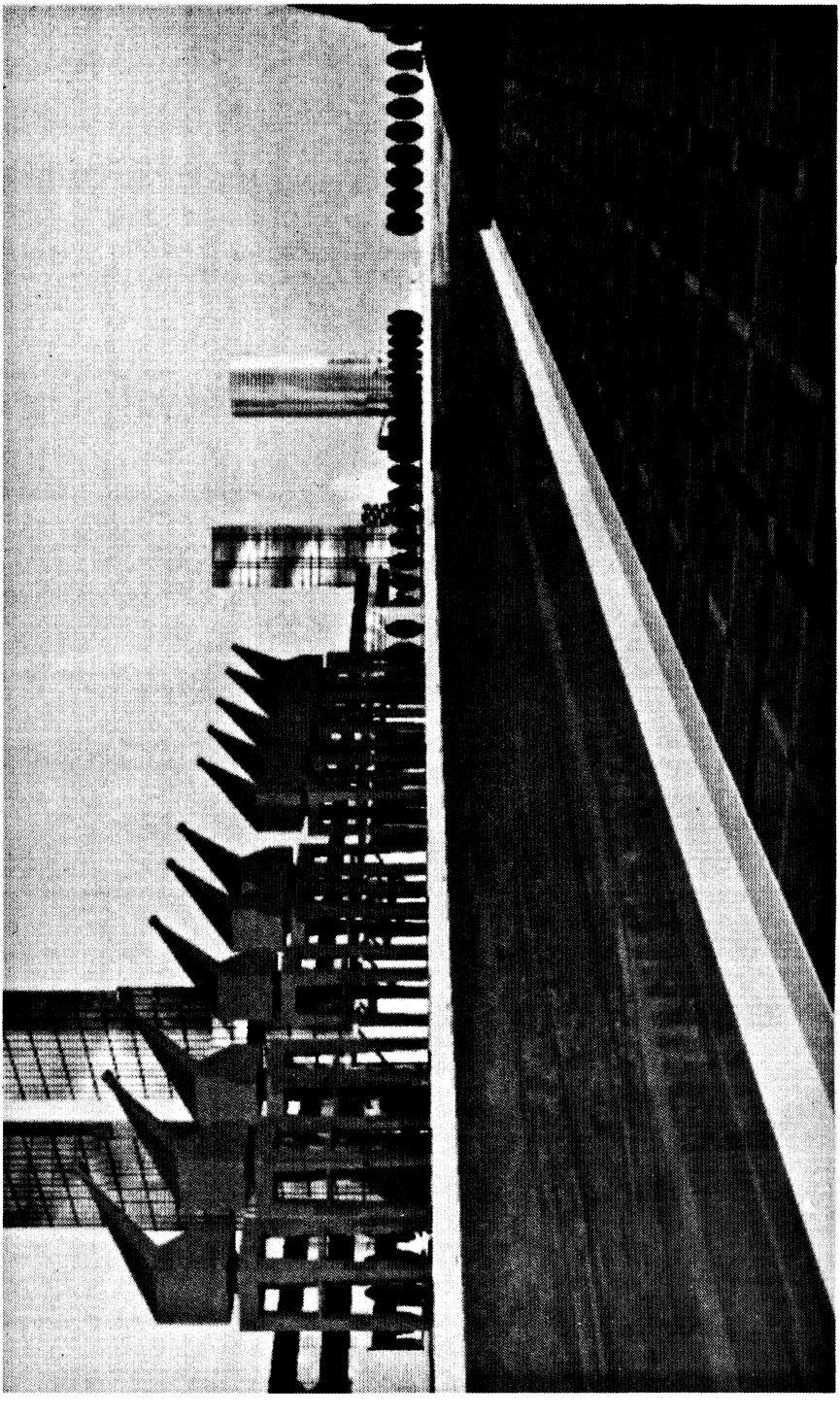


Fig.11: Perspective View of the Harbour Zone with texture mapping at 6p.m