COMPUTER GRAPHICS

4.1 INTRODUCTION AND BACKGROUND:

The previous chapter analysed normal graphic communication possibilities. This chapter investigates the proposition that graphics created by computer should give the designer a wide range of options and alternatives, and allow for personal preference.

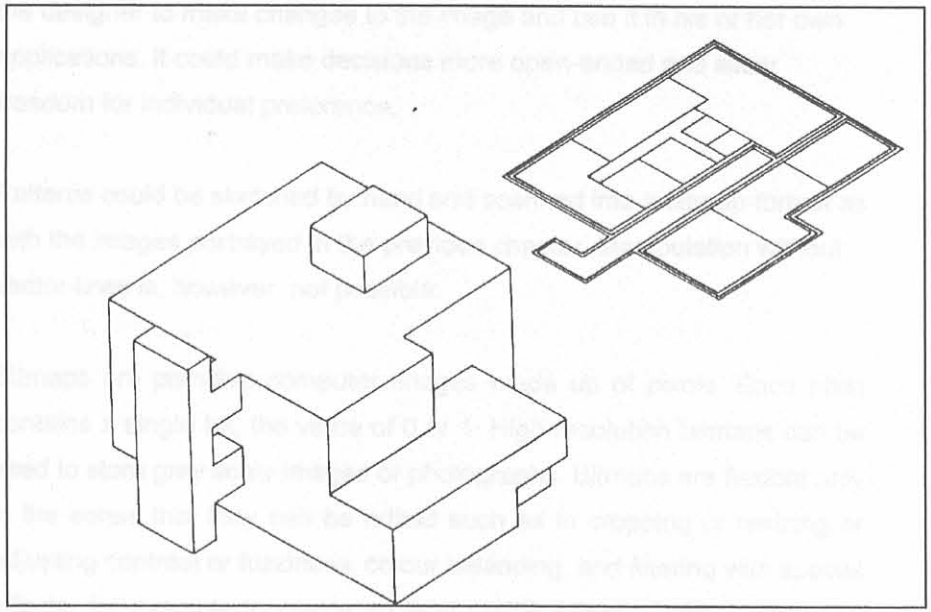


Fig 4A Early Computer Systems: *3D CAD image*

Computer graphics have developed rapidly over the past fifteen years as more powerful computer systems have become a common commodity in the architectural profession. In architectural practice the early computer applications were based mainly on the technical aspects of documentation. Few applications saw the need for a design-tool. The software could produce only basic 3D images (see Fig 4A.) Recently however, much development has gone into software programmes that give architects mostly 3D images in which to develop their designs.

Computer-aided draughting and computer-aided design (CAD) have also focussed recently on the interaction between the 2D and 3D planes. Architectural software companies, like *Autodesk (Autocad)* and *Bentley (Microstation)* in the USA and *Informatix (Micro-GDS*) in the UK, have developed programmes through which designers can create 3D elements or objects and allow the programme to create 2D technical documentation from these.

The *Bentley Microstation Triforma* CAD software programme was developed initially by mechanical engineers, designing the working parts of mechanical machines and plants. These are created in 3D and 2D shop drawings are 'automatically' created from them, the object is then manufactured from the drawings. The researcher was able to use

academic versions of *Microstation Triforma* and *Micro-GDS* for the purpose of this study. They were utilised for most of the examples of patterns created in computer graphics.

4.2 SOPHISTICATED OR PRIMITIVE COMPUTER IMAGES:

When using a computer with a user-friendly software programme as an instrument to assist designers, the computer's potential should be optimised by using sophisticated images and CAD-type programs to give the designer more interaction and dynamic feedback (Sanders,1996 *see Review of Literature*). This will also allow views from any angle, and allow the designer to make changes to the image and use it in his or her own applications. It could make decisions more open-ended and allow freedom for individual preference.

Patterns could be sketched by hand and scanned into a bitmap-format as with the images portrayed in the previous chapter. Manipulation without vector-lines is, however, not possible.

Bitmaps are primitive computer images made up of pixels. Each pixel contains a single bit, the value of 0 or 1. High resolution bitmaps can be used to store grey scale images or photographs. Bitmaps are flexible only in the sense that they can be edited such as in cropping or resizing or adjusting contrast or fuzziness, colour balancing, and filtering with special effects, for example to create an 'embossing effect'. Bitmaps are used extensively by Graphic Designers.

Vector lines in a CAD environment, which are mathematical lines in a mathematical 2D or 3D model, are more sophisticated, can be manipulated and therefore can be much more flexible and powerful in portraying patterns. In *Microstation Triforma* the images can be rotated in 3D from any angle, and 2D/3D inter-action is evident as a quarter view-window. See fig 4B (a screen dump of the software program).

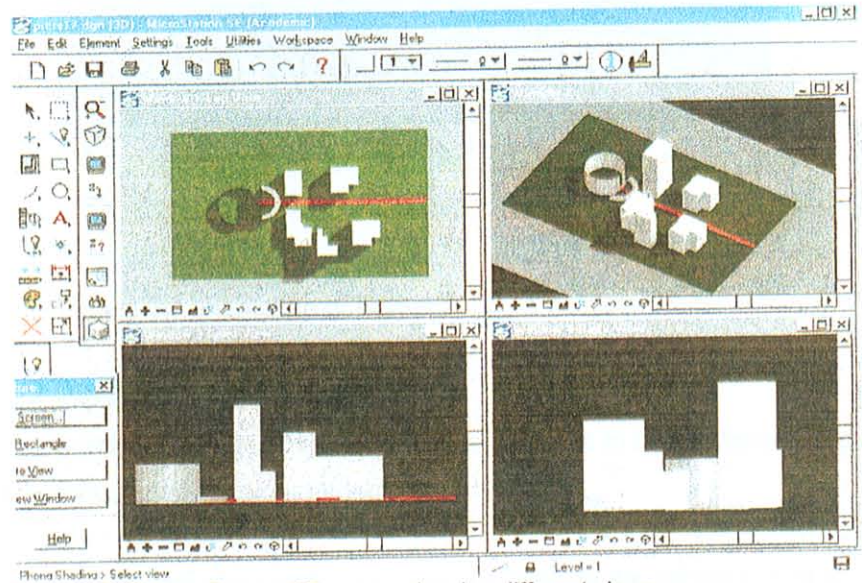


Figure 4B *Screen Dump* of Program showing different views

A user-friendly viewing tool can be made available (by software companies) to explore patterns, to give designers not only better views of design patterns but also to allow the user the freedom of exploring other possibilities. This tool can be a simple, but innovative software programme with the same viewing windows as in the *MicroStation* CAD-programme, for example.

If the patterns are imported into a CAD programme, the user can add or transform the image. Pattern files may also be exported via dxf-format files (data-exchange-format), to make it possible for any CAD-programme to read the information. A designer may well be able to build up his or her own library of patterns, incorporating or merging his own ideas or previous designs with the patterns of the design tool. The tool could well grow and be developed to suit the designer's style or expand his/her creation of a personal design pattern-library.

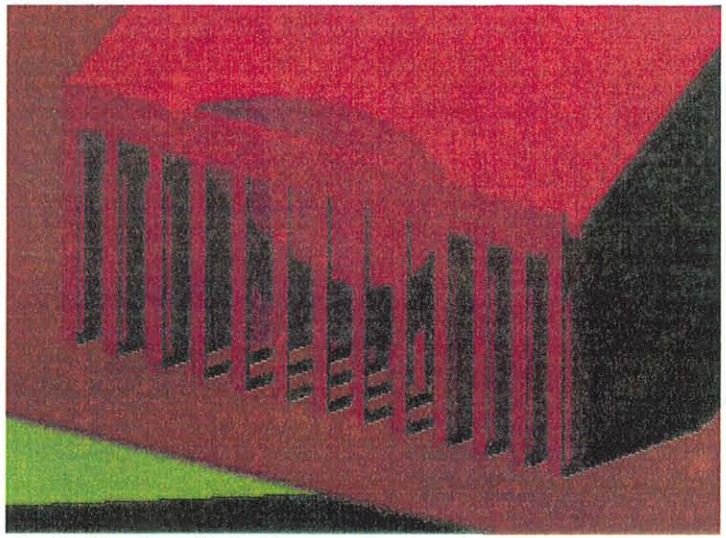


Fig 4C *Shading effect* with preceding facade

4.3 SHADING:

It is possible to create real 3D images consisting of mathematical vector lines as in any CAD program and to manipulate these images to compose a 'reality'. A reality can be composed by shading and adding light and shadows to the image. This aspect of illustration could have greater effect if the design patterns had elements which allowed light to filter through to a facade behind, for example where a screen or colonnade precedes the building facade (see fig 4C). Indicating the shading will also have value for the designer in relation to the micro-climate of the building and in determining the orientation of elements of the building.

4.4 COLOURS

Colour lines can define aspects of design patterns to be highlighted. Fig 4D is illustrated in colour to demonstrate this:

- The use of green for the base colour gives the impression of a landscaped area, thus allowing the image to convey the feeling of buildings in landscape environment.

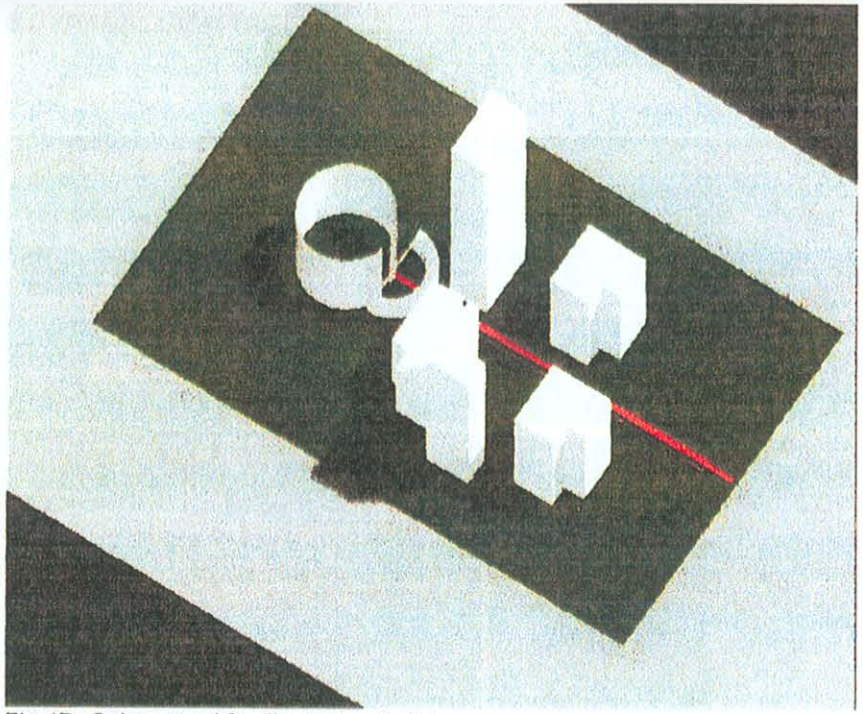


Fig 4D Colour used for illustrating *'axis'*

- The use of red to highlight the axis brings out the pattern of 'axis' and gives the other elements a sense of presence around the axis.

These aspects of colour in presenting patterns may well be further developed.

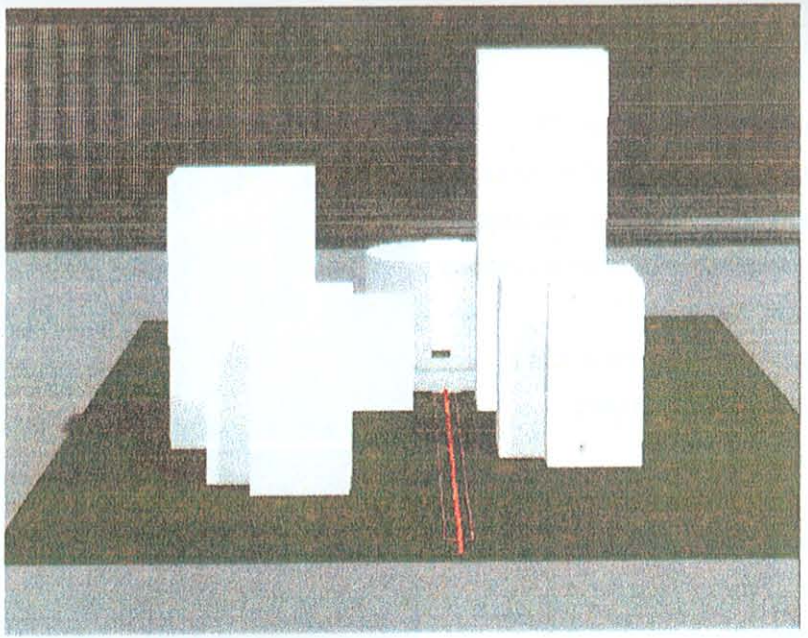


Fig 4E 3D pedestrian view : *'axis'*

4.5 3D INTER-ACTION AND FREEDOM OF VIEW SELECTION

Patterns created in 3D CAD programmes can help designers by allowing all angle views and all dimensions to be investigated. Fig 4E shows the 3D pedestrian view, emphasising the aspects of *scale, focus and axis* in the design.

The aerial view in Fig 4E shows the aspects of *form and composition of form* more clearly. This aspect of the interaction and dynamic feedback from a design tool was also analysed by Sanders (1996). *(See 2.1.3)*

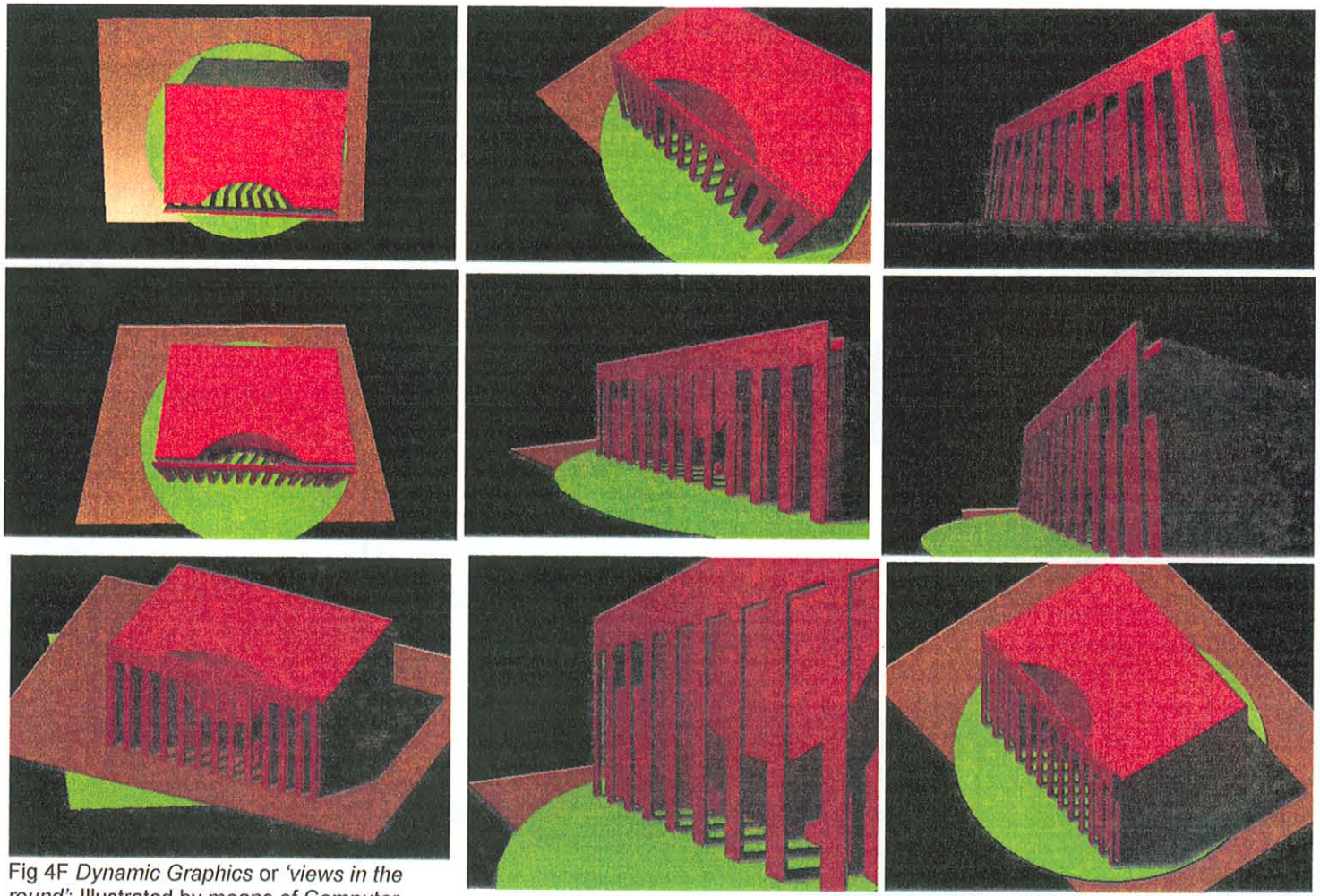


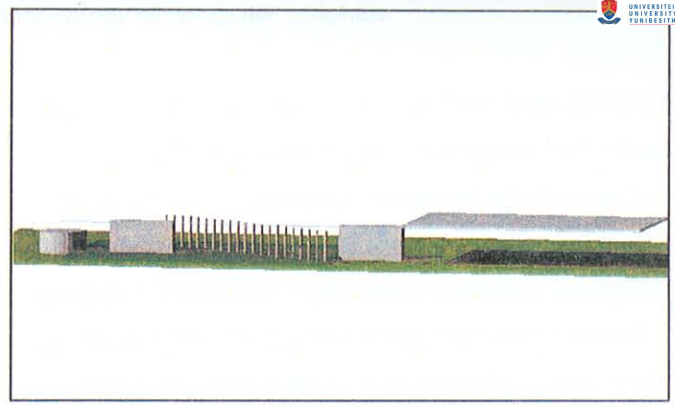
Fig 4F *Dynamic Graphics* or *'views in the round'*: Illustrated by means of Computer Graphics (Author)

Porter (1979),illustrates *'Concepts in Motion'* and creates multiple views in the round. This conveys a better understanding of form.

(It is shown in the previous chapter, section 3.4)

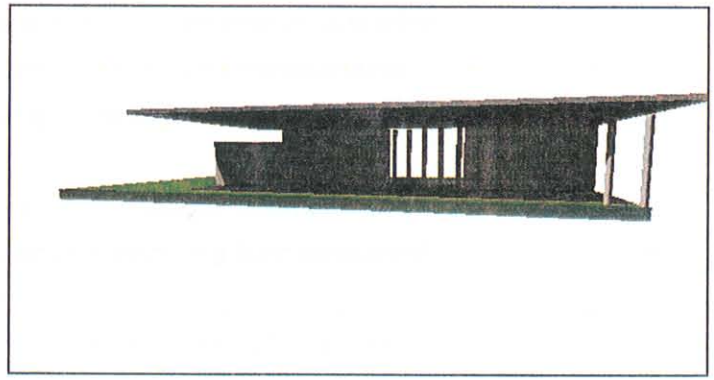
The views on the left(fig 4F) were created by the author on CAD, to explain form to the viewer, showing many different angles. Designers that have similar software could view their images from patterns according to their own preference if the patterns created are in a vector (CAD) format. The design tool should endeavour to provide this, as dynamic, interactive feedback will assist in the process of exploration and discovery.

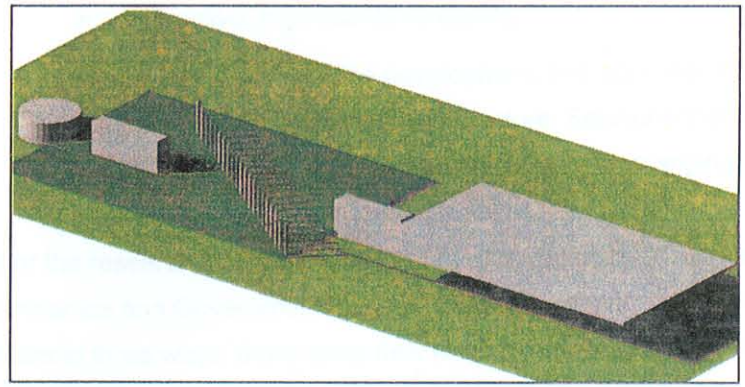
The following graphics created by the author from computer images indicate the possibilities of illustrating the design development and exploding elements of the building. The 3D-computer animation capabilities can allow the illustration of this type of images by allowing the different object-elements of a design to move away from each other. The user of the software programme may only press a button and a scene will be created by animation to show the different exploded elements.

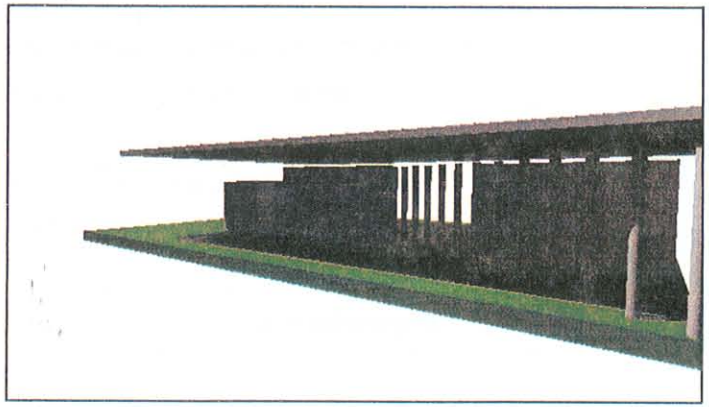


In a CAD-programme the utilising of layers to contain different elements of the design would simplify this animation process. The layers in this design concept could be:

- columns
- roof element
- box elements
- cylindrical element
- base







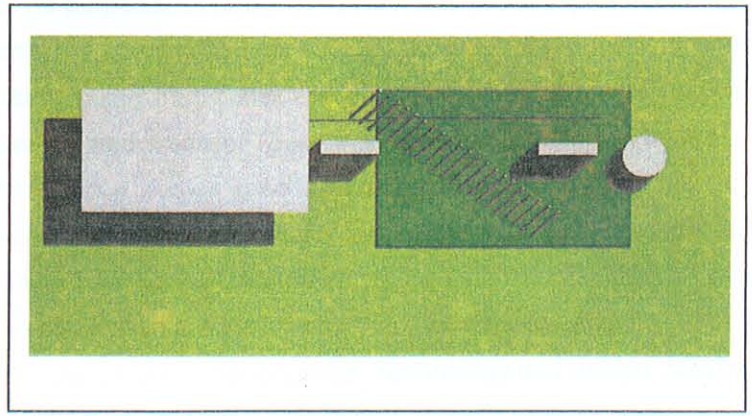


Fig 4G *Design Development* illustrated by the author with computer graphics: (This can be done by animation: exploding elements)

4.8 RECENT DEVELOPMENTS IN ARCHITECTURAL COMPUTER APPLICATIONS: CURRENT RESEARCH.

The *Massachusetts Institute of Technology (M.I.T.*) in Boston is known to be in the forefront of computer and World-Wide-Web technological developments. It has recently (1997) founded a department of *Design Technology* which is part of a post-graduate school and a research institute under the Faculty of Architecture. Faculty and students associated with this group combine education in architecture and urban design with education in computer graphics, art, mathematics, and other fields. The following research fields are active (all are centred around the application of computer technologies in design) :

- Architecture Representation and Computation: Innovative use of computation for solving problems stemming from contexts of architectural design practice.
- Design Studio of the Future: An interdisciplinary effort between the Schools of Planning, Engineering, the Lab of Computer Science and the Rapid Prototyping Laboratory which focusses on geographically distributed electronic design and work collaboration issues.
- Sustainable Form Group: Focussing on how a broader concern for the environment and related issues can translate into a set of viable design strategies.
- Computation of Shape Grammars: Finding formal machinery to calculate three dimensional solids in solid modelling in the technology of computer graphics.
- Computer Graphics in Visualisation: The development of computer graphics algorithms and interactive techniques in the service of difficult visualisation problems which arise in architecture and related design settings. including modelling and rendering of weathered materials and surface appearance, image based modelling and editing, high-performance visualization of urban scenes, acoustic design and modelling, and interactive, high-fidelity rendering.
- Kinetic design group: The development and application of intelligent kinetic systems in architecture: Solutions that are not merely flexible and adaptive but responsive to changing individual, social and environmental needs.

All of the research institutes receive sponsorships from Corporate Companies and Government funding. Research related to design inquiry occurs in three ways: developing new ways of harnessing the computer for the purposes of design; observations and analysis of the activity of design in various settings; and development of propositions about design arising mainly from consideration of important influences on design teaching and practice. These three areas of study, design and computation, design in settings, and influences on design, are often necessary components of a single research project. Students at the Design Technology Department, in the PhD and the MArchS program take subjects in the theory and practice of design and computation,*computer graphics*, Technology and design, *building*

typologies, and the *design process*. (The topics in italics are also to be found in this study.)

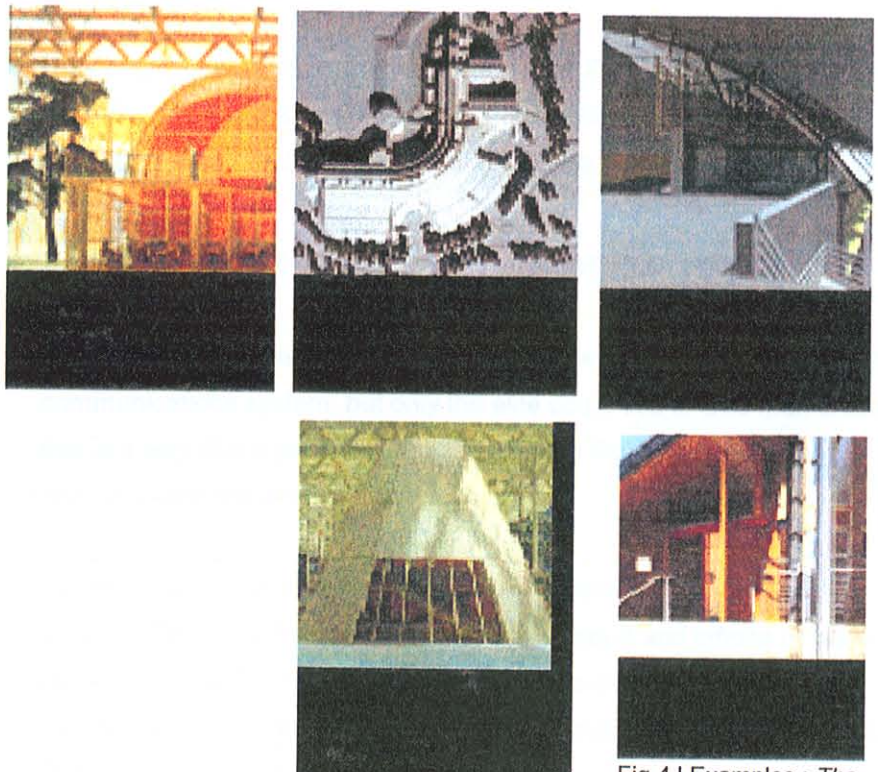
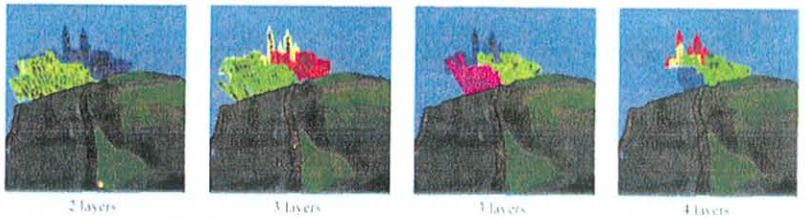


Fig 4J Examples : *The Sustainable Form Group* - work at M.I.T.



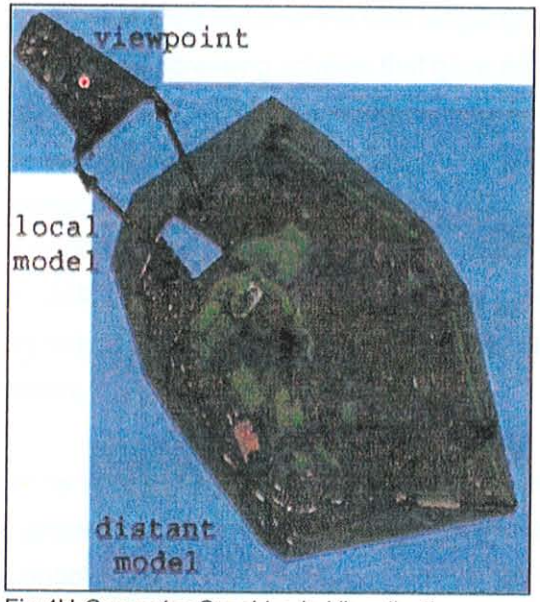


Fig 4H *Computer Graphics in Visualization* created at M.I.T in visualizing 3D modelling in Urban Space on large scale

Computer graphics has shown many new capabilities to graphics as communication. The following Chapter will analyse *the vehicle* to deliver the design patterns to the designer in the form of a user friendly tool.