

CYBERSPACE

ESCAPING FLATLAND

A STUDY OF DESIGN IN THE VIRTUAL
ENVIRONMENT

by

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Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

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Committee Chairman: Ronald Daniel
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College of Architecture and Urban Studies

(ABSTRACT)

Architecture is a spatial reality and, as such, should be designed spatially. Traditional methods of two dimensional design offer limited insight to the nature of the built project. By designing a project in three dimensions from its inception, an architect comes closer to the actuality of the building. This thesis addresses the possibilities and realities of three dimensional computer aided design.

Radical changes in computer technology have made interactive three dimensional design possible. Clusters of processing units acting in parallel offer unprecedented flexibility and computing power. New methods of input such as voice and gesture activation are allowing greater flexibility of input. The future of three dimensional computer aided design points to higher resolution displays, holographic imaging, and spatial object manipulation.

The vehicle for this architectural thesis is a computer research facility; The National Institute for Advanced Media. The project addresses the demands that new computer technologies place on architecture. It also offers a direction for designing with these new technologies.

This thesis contains an analysis of the architectural project, a complete description of the architectural process, and a summary of all software packages considered. The Apple Macintosh IIx was chosen as the hardware platform for this investigation because of its object oriented graphical environment and for its advanced multimedia capabilities.

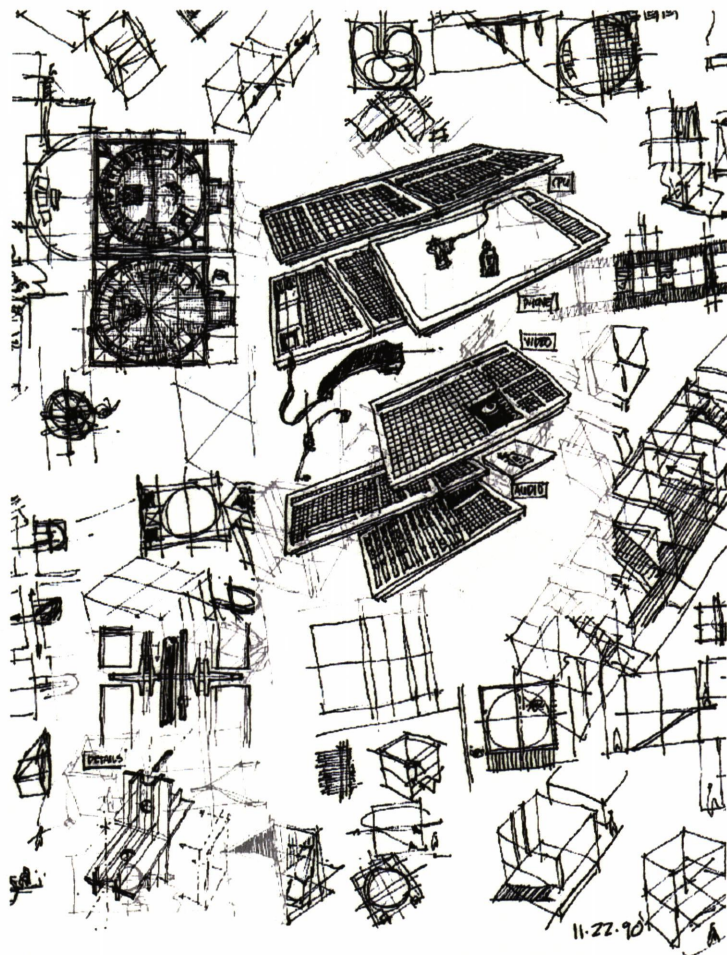
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This body of work is dedicated to my loving wife
without whose patience and support none of
this would have been possible.

I would also like to express my appreciation to the
members of my committee, my friends and my family
for their continued support on my behalf. This work
was made possible by all those who have shared a
common vision. Thanks to Ron Daniel for the foresight
and the courage to pursue the everchanging
boundaries of Architecture. To Jay Stoeckel and Bill
Galloway for lending focus in the midst of chaos. To
Benny for the many months of encouragement and
friendship. Thanks to Andy, Tim, Jack, Mike, Rob,
Craig, Jason, and all the others too numerous to
mention. To my Mom, Dad, for
their unwavering support... not to mention that very
first computer.



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cybernetics (si'bernet'iks) *n.* study of the automatic controls governing the operation of complex electronic machines and animal nervous systems. 1948, American English, formed from Greek *kybernétes* steersman, pilot (from *kybernan* to steer) + English -ics; see **GOVERN**. The word was coined by Norbert Wiener, 1894-1964, American mathematician.

-cybernetic *adj.* 1951, back formation from cybernetics. **-cybernate** *v.* 1962, back formation from cybernation. **-cybernation** *n.* automation through the use of computers. 1962, formed as a blend of English *cybern(etics)* + (*autom*)ation.

space *n.* borrowed from Latin *spatium* room, area, distance, stretch of time.

cyberspace *n.* the existence of a computer generated reality or space or controlling any such generated environment by computer. Developed as a current media phenomenon, source unknown. Term developed in opposition to existing terminology *virtual reality*. 1991, formed as a blend of *cyber(netics)* + *space*.

CYBERNETICS

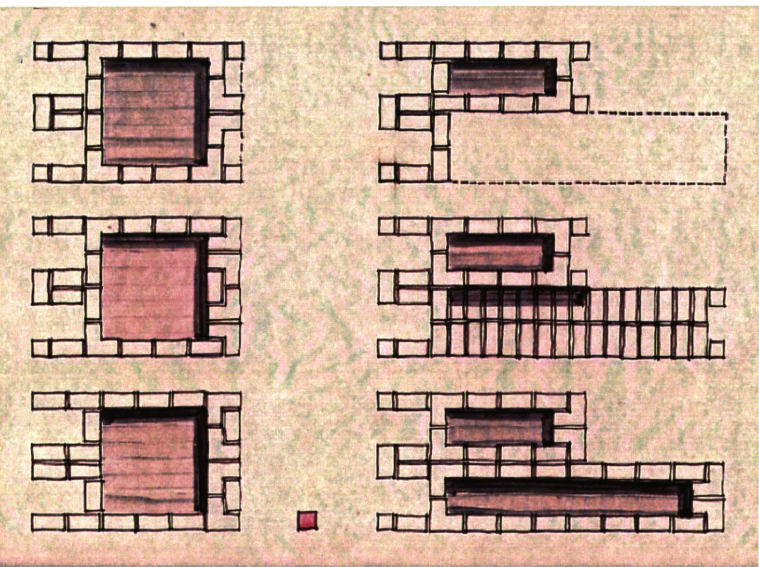
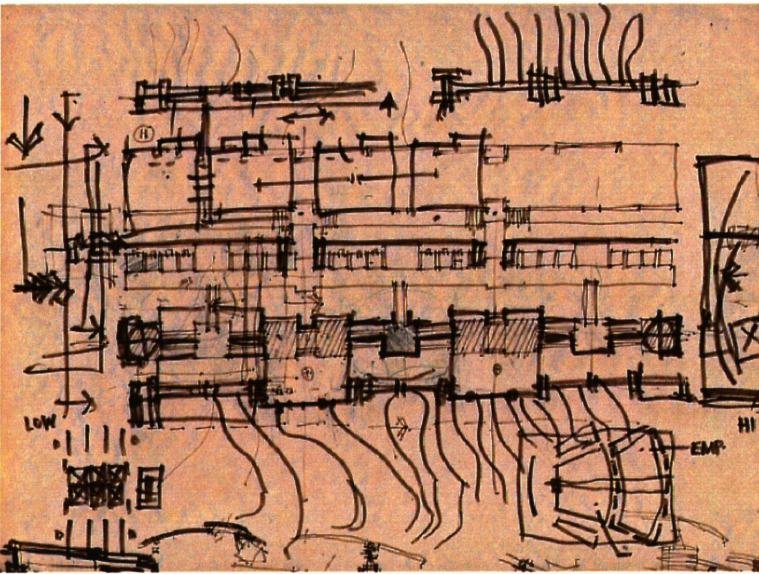
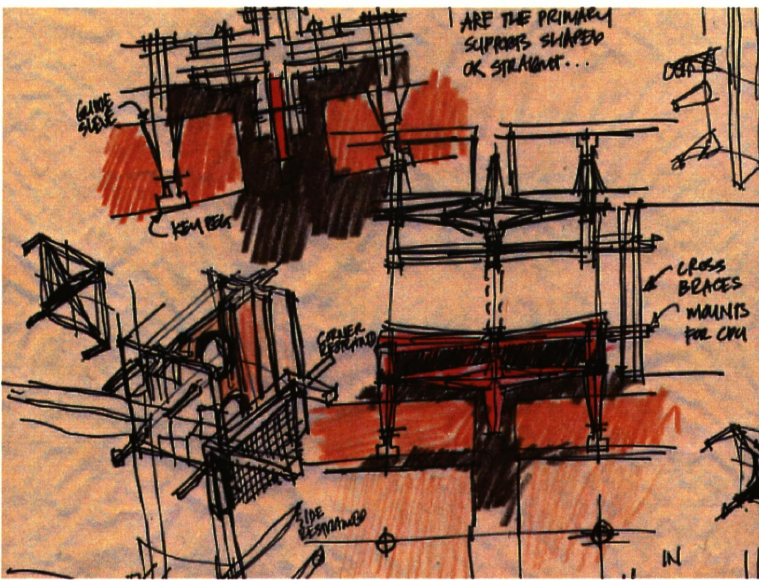
CyberSpace is a current media term used to describe an environment that is wholly computer generated. The term was derived from the need of the computer industry to find a proper terminology for the emerging technology of computer based reality. The term "virtual reality" has been used, but lacks a certain descriptive quality for the true nature of the medium.

CyberSpace takes its name from the early 1960's studies in "cybernetics", a term coined by its creator Norbert Wiener. Cybernetics was defined by Wiener as "the science of control and communication, in the animal and the machine." In the 1960's, books on the "theory of machines" often dealt with the mechanical aspects of machines. Cybernetics is also a theory of machines, but one that deals not with things but "ways of behaving." Cybernetics does not ask "what is this thing?" but "what does it do?"

Cybernetics typically treats any given, particular, machine by asking not "what individual act will it produce now?" but "what are all the possible behaviors that it can produce?" Thus, information theory plays an essential part in the investigation. Information theory is characterized by dealing with a set of possibilities. Its primary output and final statements are about the sets of possibilities, and not about an individual element of the set.

Cybernetics envisages a set of possibilities much wider than the actual, and then asks why a particular case should conform to a particular restriction. The nature of the system is rarely important; what is important is the extent to which the system is subject to determining and controlling factors.

The most fundamental concept in cybernetics is that of "difference". Either two things are recognizably different or one thing has changed with time.



Traditional Tools

Traditionally, the tools for the practice of architecture have been about manually marking a flat surface so that documents could be moved, stored, shared, and duplicated. The last decade has seen a dramatic increase in computer technology. This technology was embraced by the architectural profession at its inception. However, architects have not evaluated the way in which the technology is used.

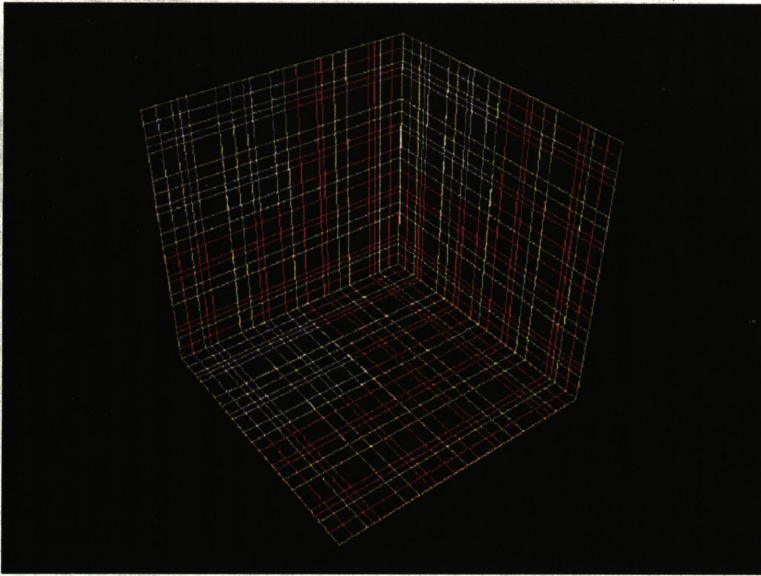
Early visionaries saw an opportunity to delegate complex and repetitive tasks, normally done by hand, to a computer. The computer executed time consuming and repetitive tasks quickly, without error. Early computer technology was marred by basic problems of execution and difficulties in developing a viable way to input, store, manage, retrieve, and distribute information. The problem was that the right questions were not asked of the technology. We wanted the machine to behave like we did, do the things we did, and execute those commands with as little help as necessary. The question that should have been asked was, "what can this technology do for us that we can not do?"

Computers today are small and getting smaller--and more powerful. Today, many people have access to computing power once reserved for government, industry, or large universities. These people *are* beginning to ask the right questions such as "why does this have to be done this way" or "why can't it be done another way?". Computer hardware and software is changing to answer these questions. The profession can be pushed beyond the limitations of manual tools. The computer can give something to architecture that it has never had before because we are beginning to question how we interact with and relate to the computer.

Future Tools

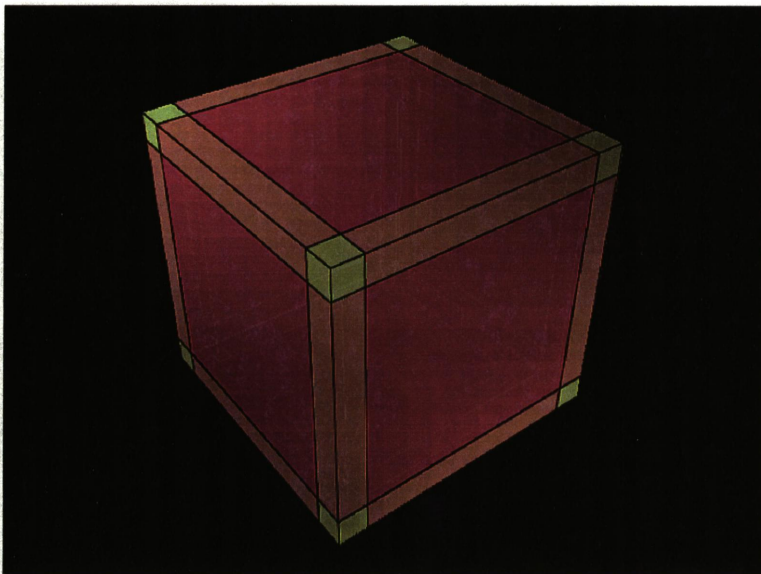
Today, computers are performing not only menial and repetitive tasks, but tasks that no human could ever visualize. The role of the computer in the architectural profession is being redefined. This thesis seeks to explore the boundaries and consequences of designing wholly by computer, using a consortium of software on a Macintosh IIx.

The project is based on and developed along the theories of cybernetics. The project chosen for this architectural investigation is a computer research facility. A facility of this magnitude is very complex and best examined through the architectural possibilities of the specific needs of the building type. The project deals with the relationship between two dissimilar sets, asking not what they are, but what are the possibilities of such a relationship.



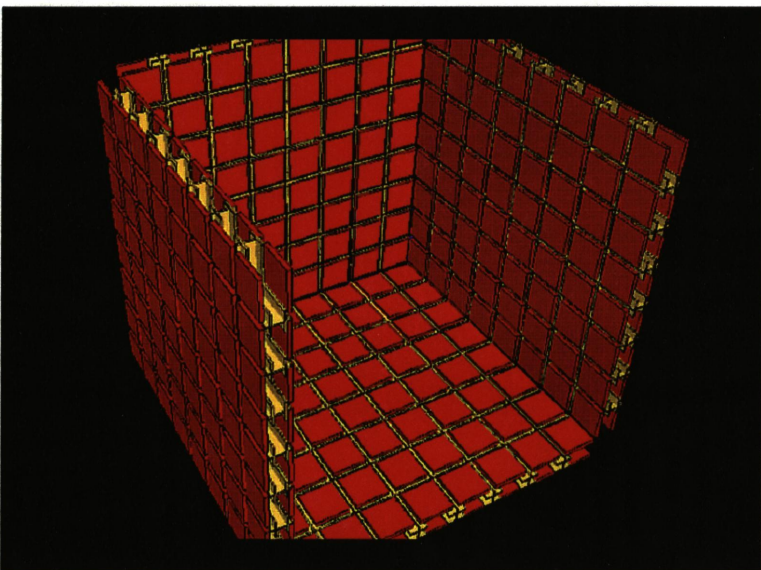
The Spatial Grid

The idea for the project began as a layering of two separate spatial grids. Unlike a simple 2D grid, the 3D grid allows the pieces of the design to be located spatially. The potential for interaction and modulation, discovered immediately in the third dimension, may have remained hidden if the project had developed from a plan. The spatial grid is the intersection of a 4 part division of 100 units (25 units each) and a 5 part division of 100 units (20 units each). By resizing the grid to 50% of its original size and superimposing it on the original, a complex network of reference lines are established to aid in the development of the design.



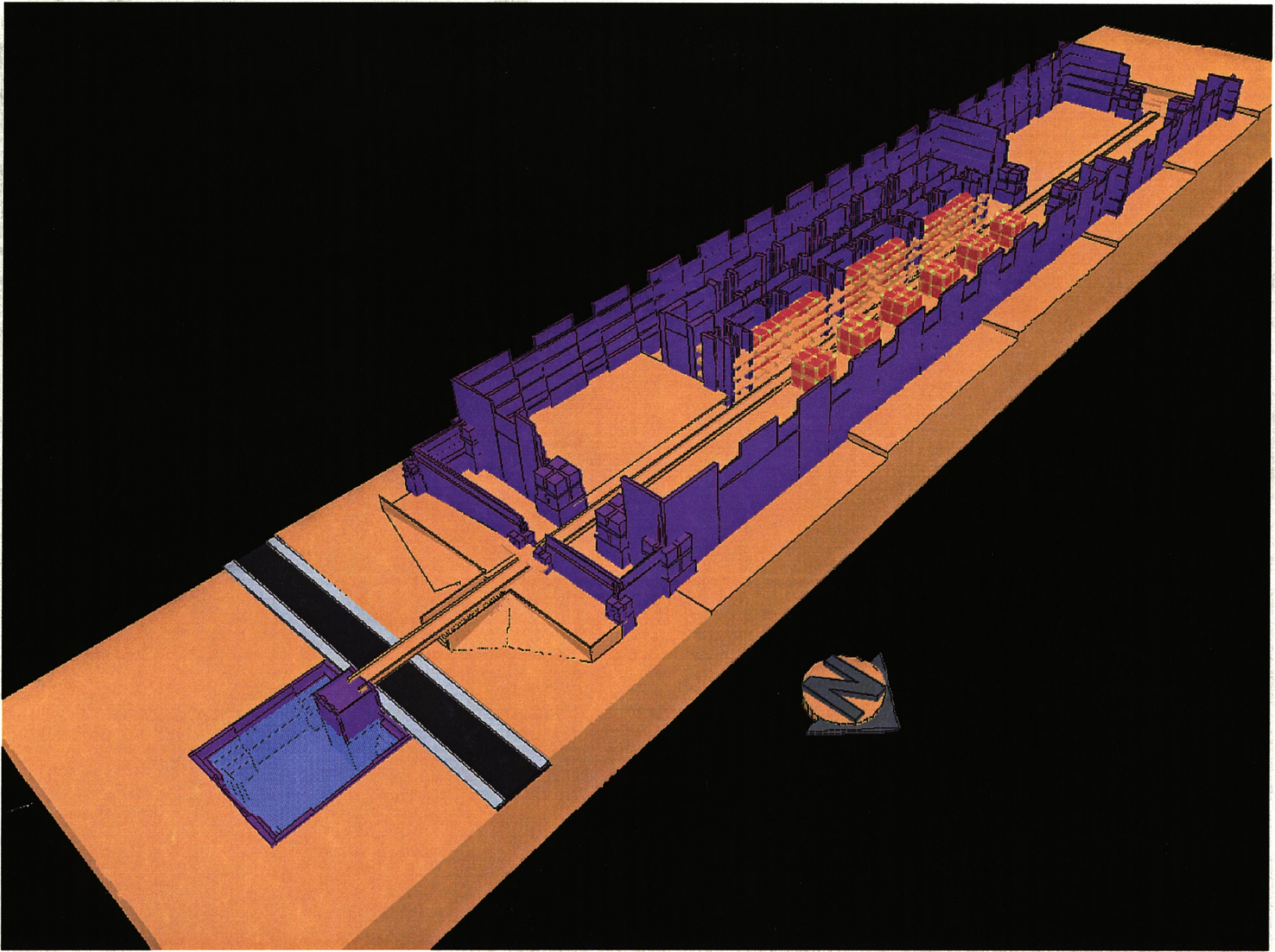
Establishing Solids

From the spatial grid lines, a network of simple solids were developed to represent where primary parts of the design might occur. Since the solids represent an abstraction of the future design, no particular scale was established. However, scale was established for one object relative to another. Thus, the relationships of the proportions were established without imposing the elements of wall, floor, or column.



Development of Form

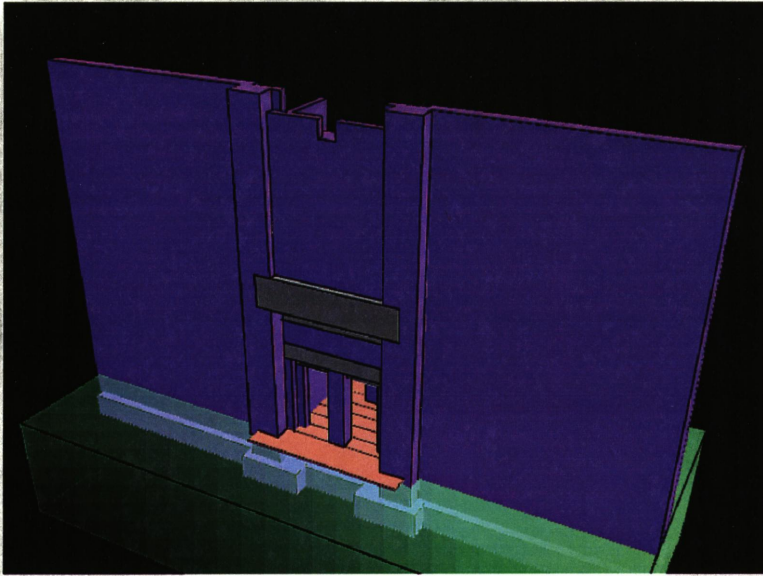
A more detailed design began to emerge when the simple solids were superimposed on the spatial grid. All elements of the project were developed by superimposing the two systems. The development shown left is the individual computer labs. The spatial grid yielded a 25'-0" square outer cube and a 20'-0" square inner cube. The wall thickness as determined by the solids was 2.5'. This thickness presented an opportunity to house all heating, ventilating and cooling (HVAC), electrical, communications, and computer equipment within the walls. Once a more precise model of the lab units was generated, a more detailed design could develop which included the location and routing of equipment mounting hardware, communication lines and electrical components. See page 6 for the final development of the lab units.



The National Institute for Advanced Media

The above image is a view of the entire project. The cluster of lab units run east to west along the spine of the building. Living quarters are housed at the south side of the building. The suspended walkway in the middle of the project connects the eastern lobby area with the large auditorium at the west end. The axis established by the walkway continues beyond the building, providing a connection with the road beyond the entrance. The freestanding structures on the north side of the building are larger 50'-0" by 50'-0" exhibition and presentation areas flanking the walkway and facing the lab spaces.

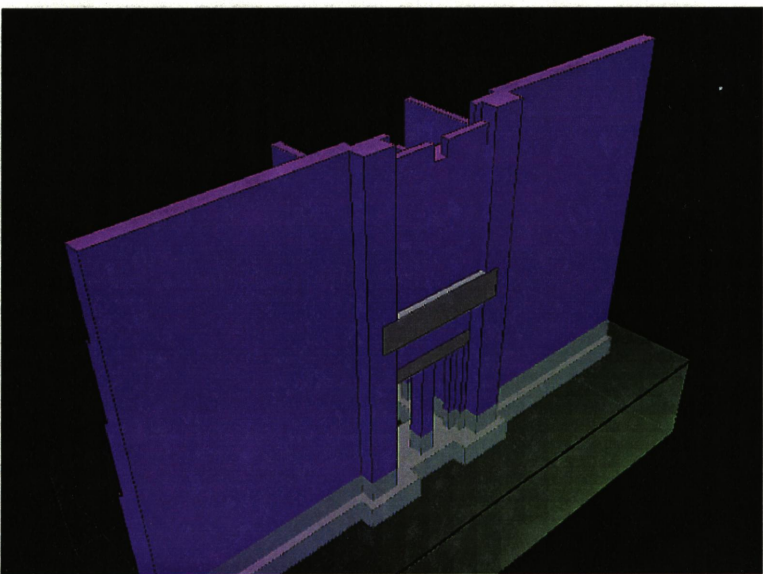
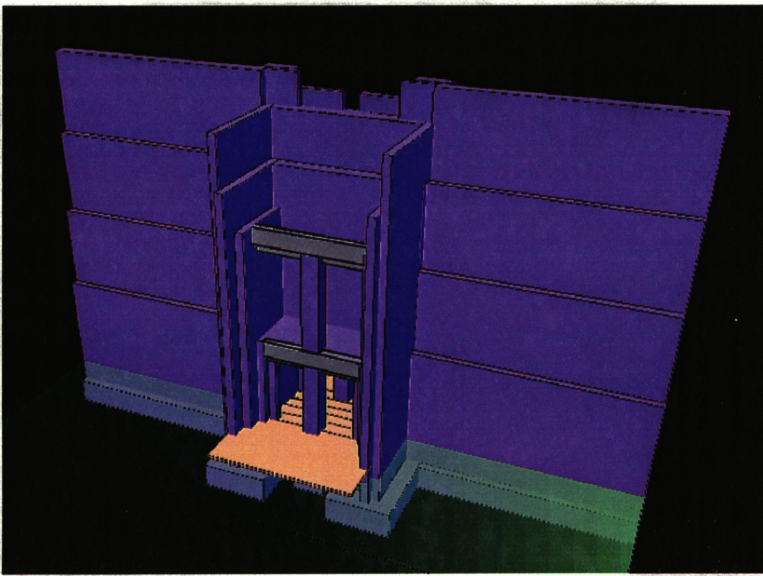
Large projects, such as this one, must be investigated with several models at several scales. Considerable computing time would be used to calculate each plate and bolt for the project. These items would pollute the image with extraneous and illegible information at this scale. Often, fewer elements results in a cleaner, more legible model.

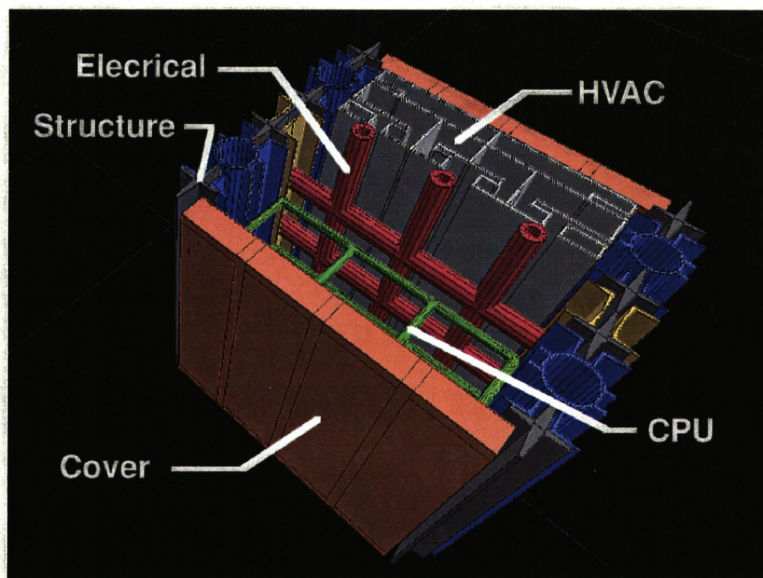


The Masonry Walls

The project has two major types of structures -- those that are dynamic and reconfigurable and those that are permanent and static. The permanent masonry walls provide a place for the dynamic steel parts to exist. The masonry walls are constructed of concrete and 3" x 6" x 12" solid bricks. The bricks acts as the formwork for an enduring concrete filled wall. This method of construction dates back over 2,000 years to the Romans who made walls by forming a shell of brick and then filling these piers with what closely resembled concrete.

The images on this page show the development of a doorway between groups of computer labs. Notice how the detail of the design has changed from the model of the overall project. Note also the changes to the masonry wall in the model of the labs on page 6.



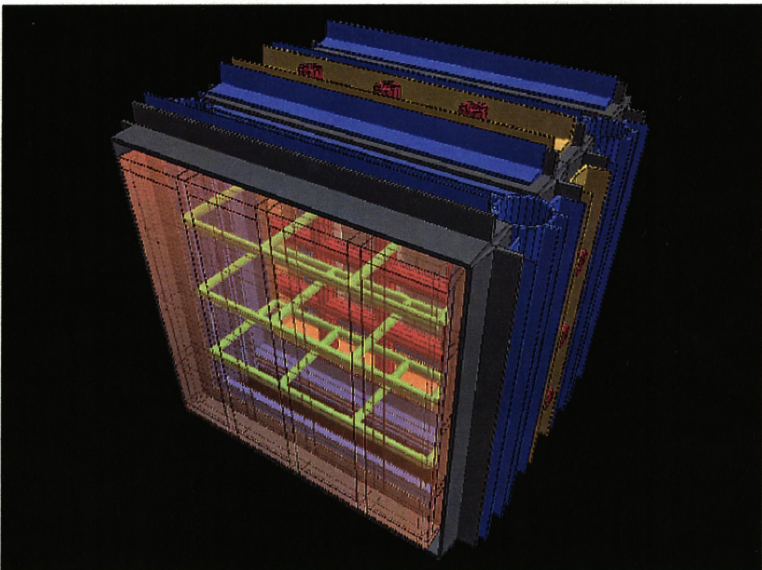
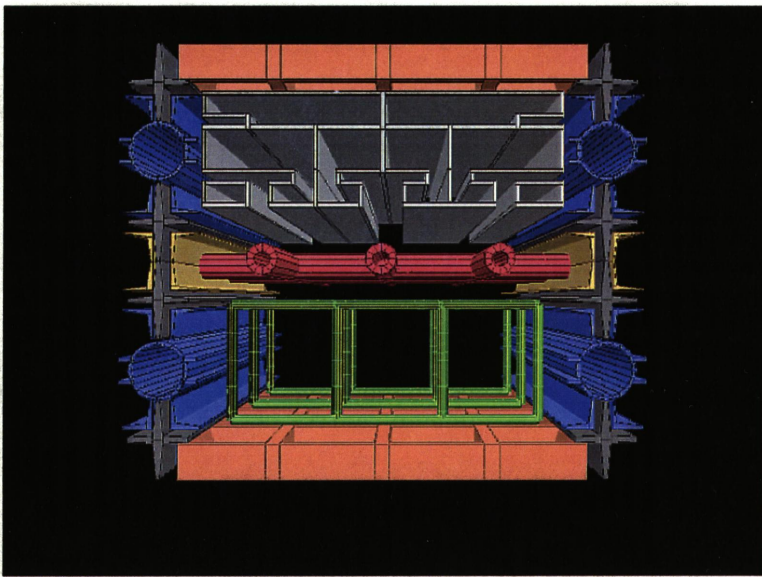


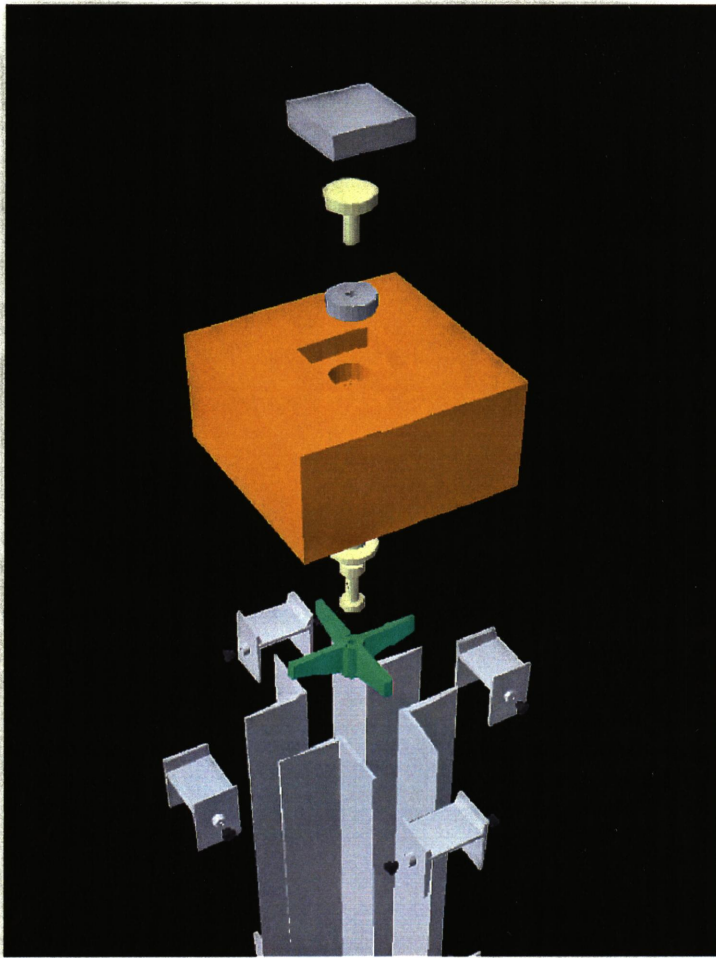
The Computer Labs

The design of the individual computer labs developed as a cube inside of a cube. The space between the two cubes are used to house support equipment. Each lab is a two story space with entrance and meeting facilities on the upper floor. A hydraulic 5' x 5' lift provides circulation between floors. Essentially, each lab has its own internal elevator system. Panels between adjoining labs can be removed for access to more than one lab. Primary communications occur in the ceilings, floors and suspended floors within the rooms. Therefore, breakdown of the side walls will not disrupt communication or power.

The panel system developed for this project houses the HVAC, communications and electrical as well as the computer hardware and storage. The HVAC is located on the outer layer of the walls 2.5' thickness. Air is filtered through hollow structural supports and fed across the computers for cooling. This system also provides heating and cooling for the lab. Communication and electrical run along the center of the 2.5' wall thickness. The innermost layer of the wall houses the central processing units (CPUs) and the parallel processing units (PPUs). All of the CPUs and PPU's within the building complex are networked to provide one massively parallel universe. To update or reconfigure a machine a technician need only remove the carbon-graphite epoxy panel and replace or update existing hardware without the need to replace an entire machine. Parallel computing offers the added flexibility of allowing separate and dissimilar processors to work together for maximum efficiency.

Today's most sophisticated computers have over 16,000 processors on board, each many times slower than the original Apple Macintosh. Because these computers work in parallel and not in series, the net gain is phenomenal. This design is developed to take advantage of this new and emerging technology. The computing power of all 27 labs can be directed to one task, if necessary. As demand increases, the system can reconfigure itself automatically to allow multiple users while still delegating tasks to the remaining processors.



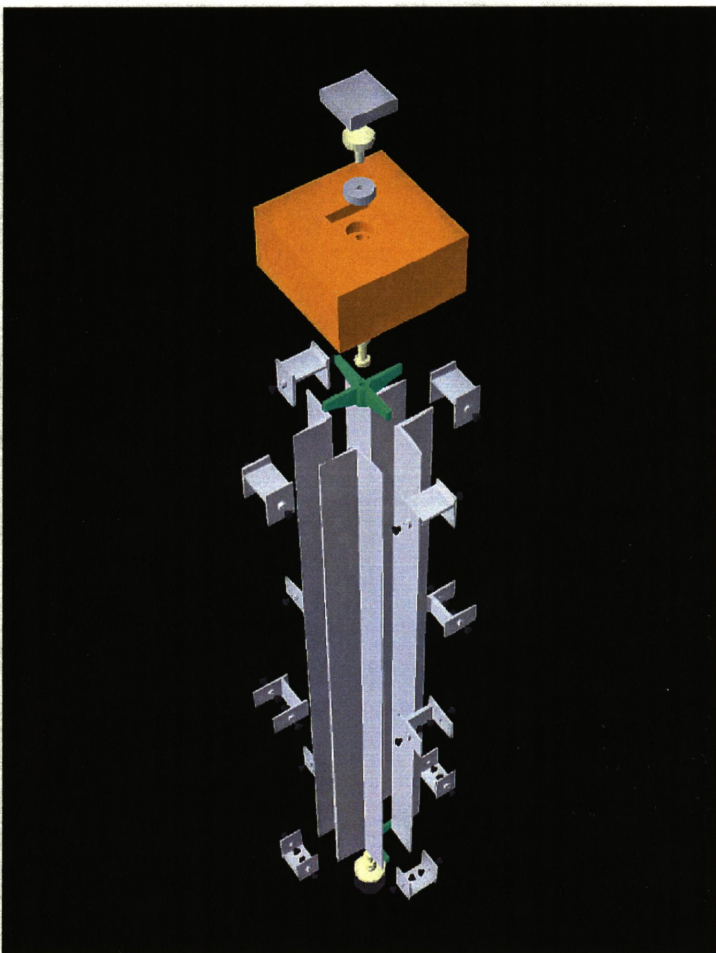


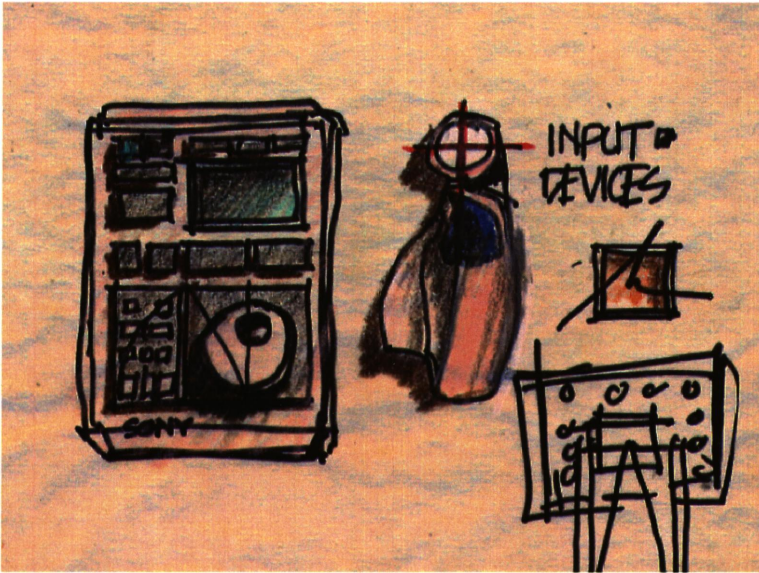
The Details

With a grid of 1/16th of an inch it is possible to develop details such as the steel support (shown left). Size, shape and location of all parts of the design can be shown. It would be virtually impossible to model the overall project at this scale. Too much information would be lost. Even the models for the labs lack details such as the location of bolts and fasteners. The ability to shift scales in models, know what the pieces represent, and reveal the true nature of the detail must be developed.

For this project, time and space did not permit the inclusion of all details for all models at every level. Instead, a framework for structuring additional investigations is provided and samples of various models are shown to give a direction for designing in three dimensions. Once the computer models are generated, the model may be manipulated in many ways. Shown left, the top portion of a detail is isolated and exploded to better reveal the nature of the individual pieces while still showing their particular relationship to other pieces in the design.

These images were flat shaded in DynaPerspective with the edge draw turned on for more definition of the pieces. Although this feature is available in programs like Swivel 3D Pro, it is not available using StrataVision 3D. For a complete explanation of the programs and their features see pages 9-17.



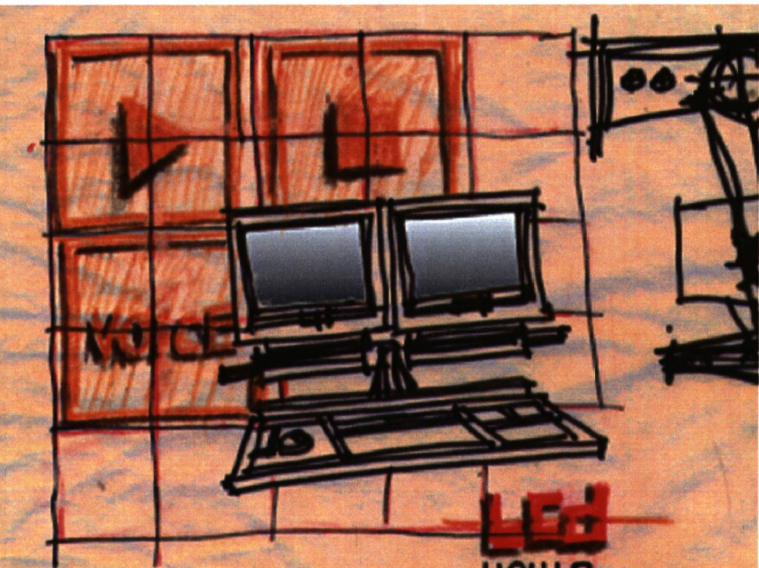
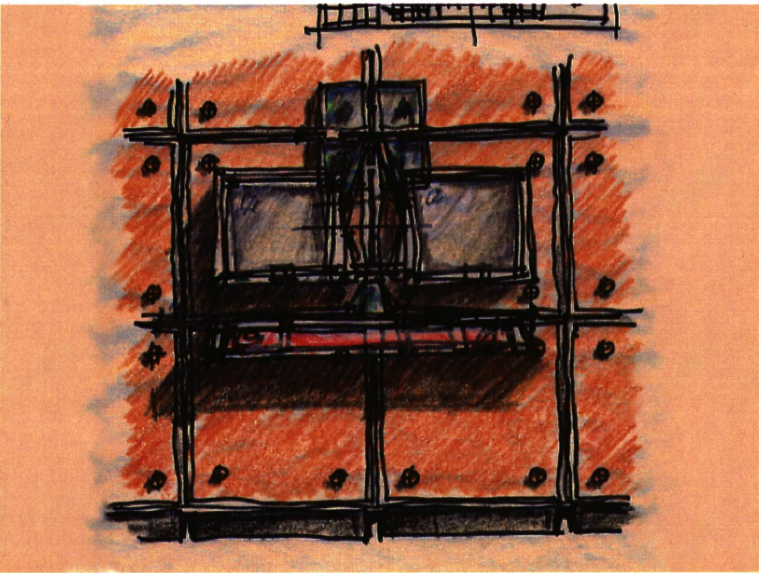


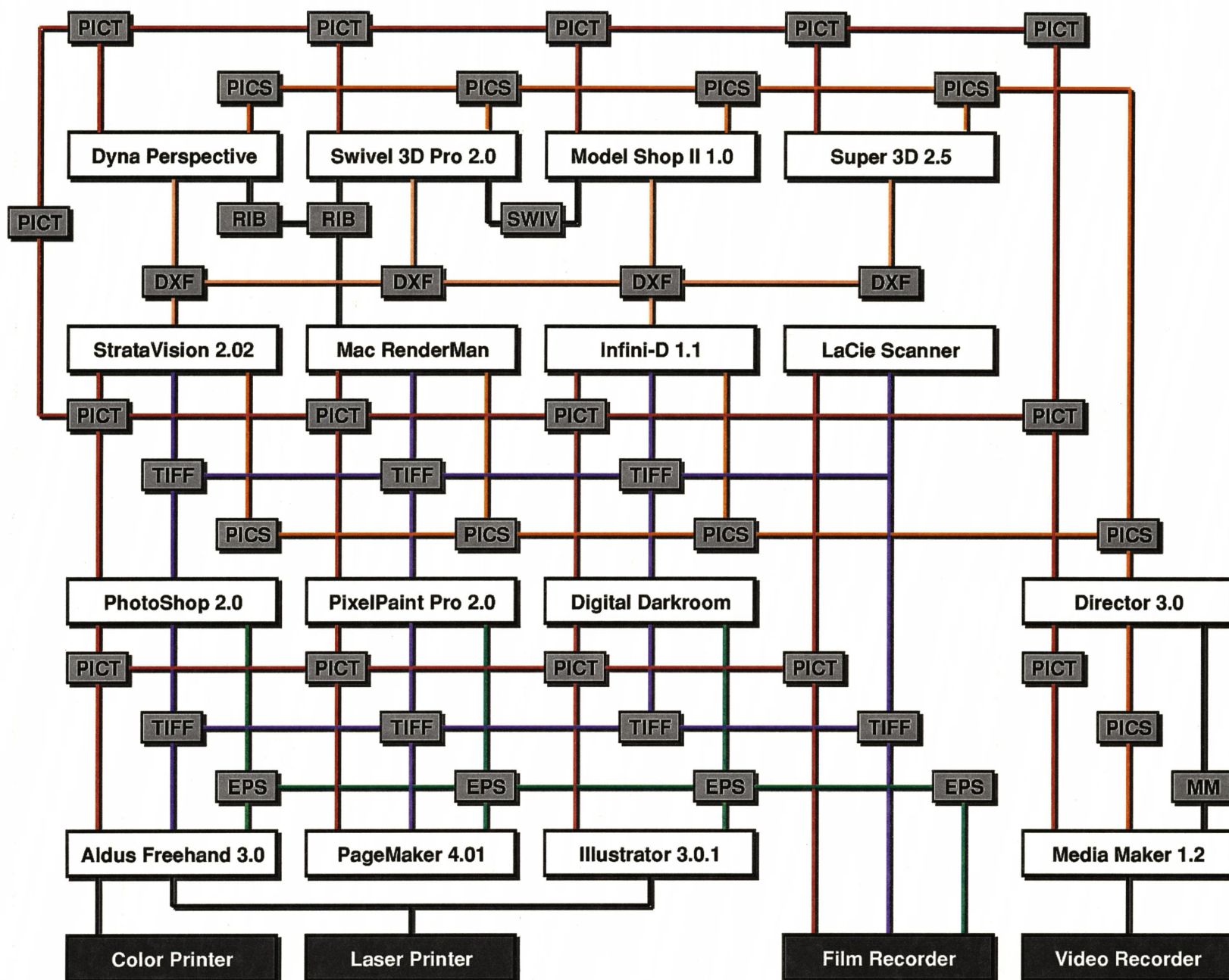
The Devices

By far the most underdeveloped part of computer is how humans relate to it. For many years, a typewriter keyboard has been employed to input words and phrases and to direct the operation of the computer. Punch card systems were developed to facilitate the programming of massive amounts of information at different sites. Despite these alternate methods of input, little progress was made in the last half century over the keyboard until 1984.

In 1984, Apple Computer Corporation introduced the Macintosh computer. It was a small, user friendly device with a sophisticated graphical user interface (GUI) and a mouse. Today, the mouse is taken for granted. But, the mouse revolutionized the way we relate to designing on the computer. In the seven years since the first Macintosh, there has been a second revolution in input devices. Voice activated design gave rise to direct manual manipulation via devices like "the data glove", developed at MIT. VPL Research pioneered the field of "virtual reality" with the introduction of stereoscopic glasses that give the wearer a true 3D depth cue of the manipulated object. The glove and the glasses offer a direction for the future.

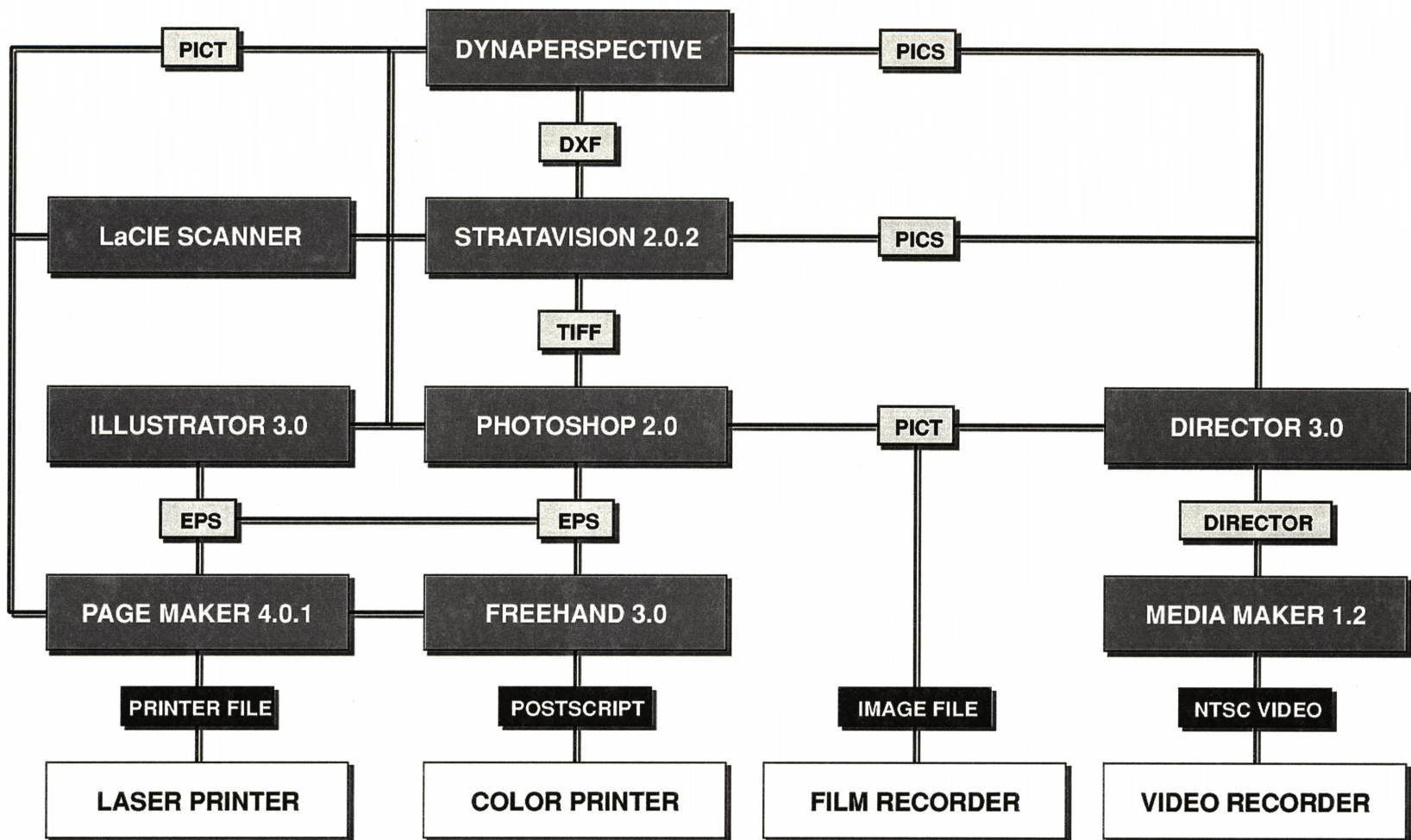
The design of the lab space allows the devices which relate to the computers to be in the lab, away from the computers which are housed in the walls. Thus, ways of relating to the computer can be adapted and changed quickly and easily without the need to reconfigure the entire lab. The not too distant future will hold a complex combination of voice and gesture manipulations. Display will be provided by holographic images so that the designer can view, manipulate, and interact with the object in 3D space.





The Software

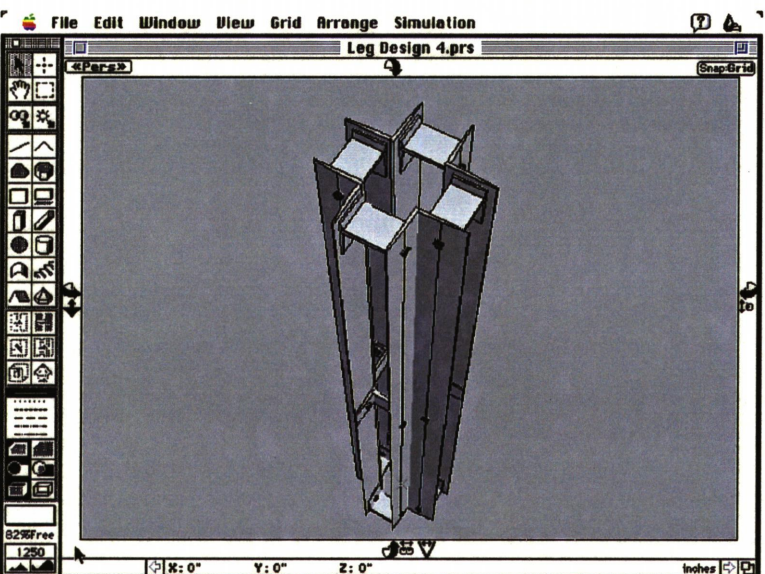
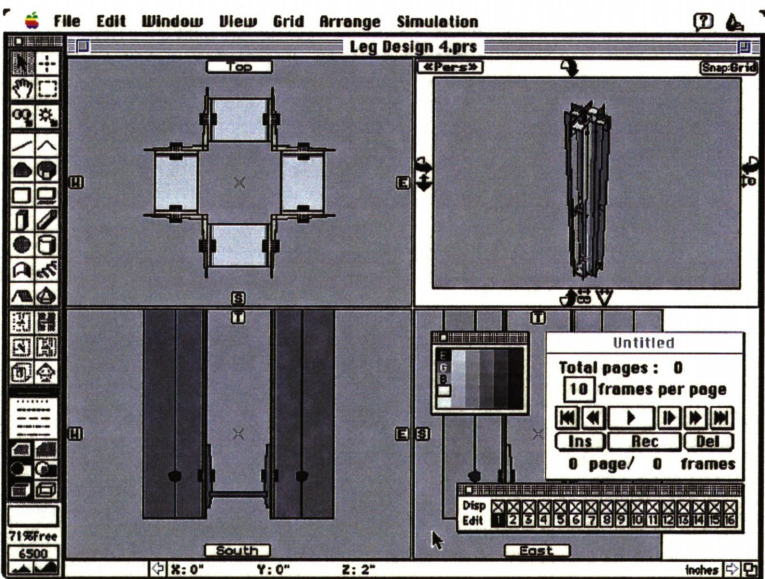
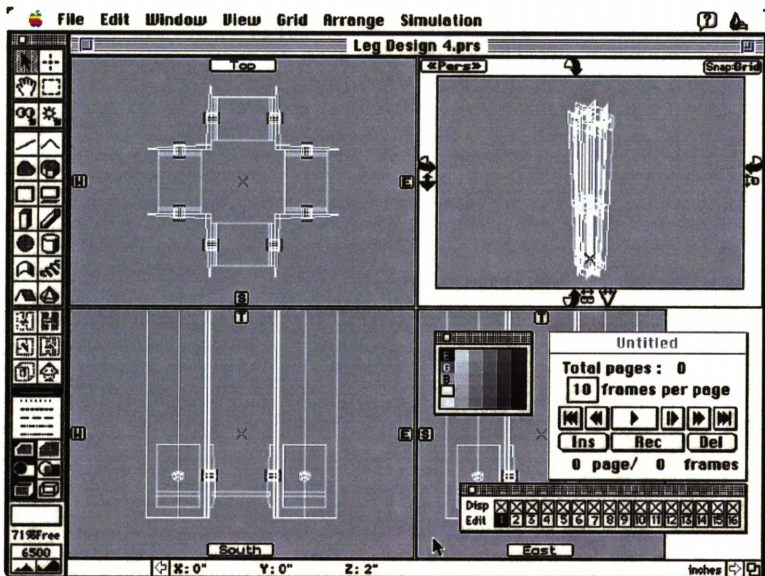
The above chart shows the relationship of the most common file input and output types. A complete list of all file types is available in the individual program discussions on pages 11-17. The programs are divided into four major groups from top to bottom. The top row lists 3D modeling programs used for object design. The row below the modeling programs are rendering programs. These programs do contain some modeling abilities but are considered more for rendering than modeling. The third row represents the most popular image processing programs. These programs are used to edit rendered images or to combine or compose images. The fourth row represents page layout and design programs used to organize images for output to the devices represented on the bottom row. Note that the far right hand side is devoted to output to video using multi-media resources. It is important to know what method of output is desired BEFORE rendering the images.



The Selected Programs

Four major software packages were chosen as the primary tools of investigation. The four packages are DynaPerspective 2.3 by DynaWare, StrataVision 3D 2.0.2 by StrataVision, Adobe PhotoShop 2.0 by Adobe Systems, Inc., and Aldus Freehand 3.0 by Aldus Corporation. These tools were chosen for their modeling, rendering, image processing and desktop publishing capabilities respectively. A complete summary of each package follows on pages 11-17.

Although many other packages could have been chosen, these four work best together. Each program has specific strengths that other packages do not have and together cover almost all design needs. A comprehensive guide to other programs is given to aid the choice of the right program for the task at hand. Choosing a program carefully is critical. The structure of the program interface predetermines the final nature of the objects designed. Objects are designed and manipulated differently in each package. Finding a package that allows flexibility is desired for creating the design.



DynaPerspective 2.3

DynaPerspective (Dyna) was chosen as the primary modeling environment because it contains features unavailable in other modeling environments. Unlike other 3D applications in its class, Dyna directly manipulates objects in three dimensions, allowing repositioning and re-scaling at anytime. Dyna is one of the few 3D modeling programs that confronts the user with the immediate consequences of his actions in three dimensions.

One of the most important features of DynaPerspective is its three dimensional grid. The grid can be visible or hidden. It can be set for a different unit of measure for each axis (x,y,z). The objects created can be snapped to the grid very precisely. Dyna supports a lock to the grid up to 1/16th of an inch. Dyna also supports a snap to other objects in the design which allows true object based placement and scaling.

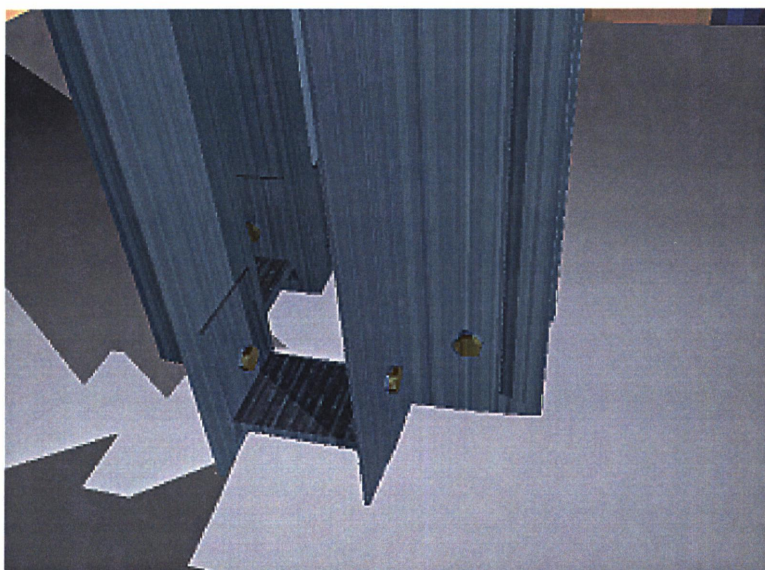
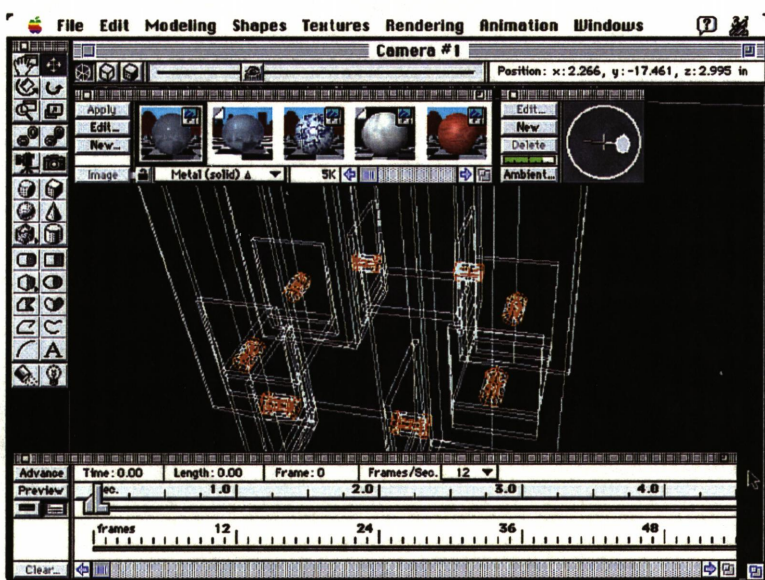
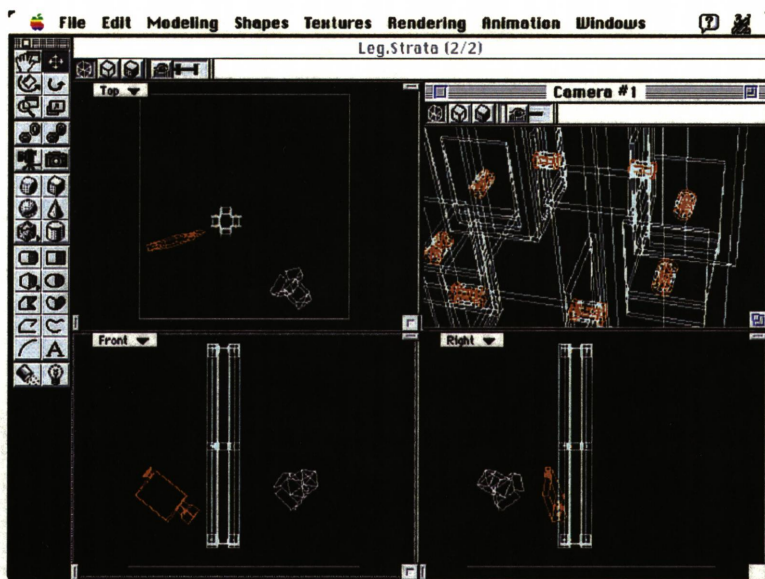
The modeling environment is presented to the user via a four view orientation of top, front, side, and perspective. The user may use the four views or toggle back and forth between any single view for a closer look. Magnification of a single orthogonal view can be from 0.01% to 67,056,000%! View angle in the perspective view can be from 2° to 178°, and with the visual controls palette, the view can be set by focal length to simulate actual camera angles.

Dyna supports only flat shading, but has the ability to render object edges, transparencies, and wireframes simultaneously. For rendered images, five levels of anti-aliasing for smoother edges can be achieved when using a 24 bit video board.

Dyna has a palette of line types to use as reference lines. Dyna has 16 modeling layers and supports 32 bit (16.7 million colors). Only a color palette of 30, 60 or 120 color can be used at any one time, and there is no system palette support to date. Custom palettes may be created, including palettes containing system colors, but it is a long and tedious process.

Dyna supports full 2D (release 9) and 3D (release 10) DXF file formats for export to more advanced rendering applications like StrataVision 3D, Infini-D, and ModelShop II. Dyna version 2.3 also supports RIB file output to PIXAR Mac RenderMan.

Dyna has powerful built-in animation capabilities. Dyna generates animations in two formats, PICS and HSF (high speed film-a proprietary format). PICS files can be transferred to MacroMind Director and MacroMind MediaMaker for output to video. The QuickPICS utility, bundled with ModelShop II, also does a great job of playing back large single or consecutive PICS files.



StrataVision 3D 2.0.2

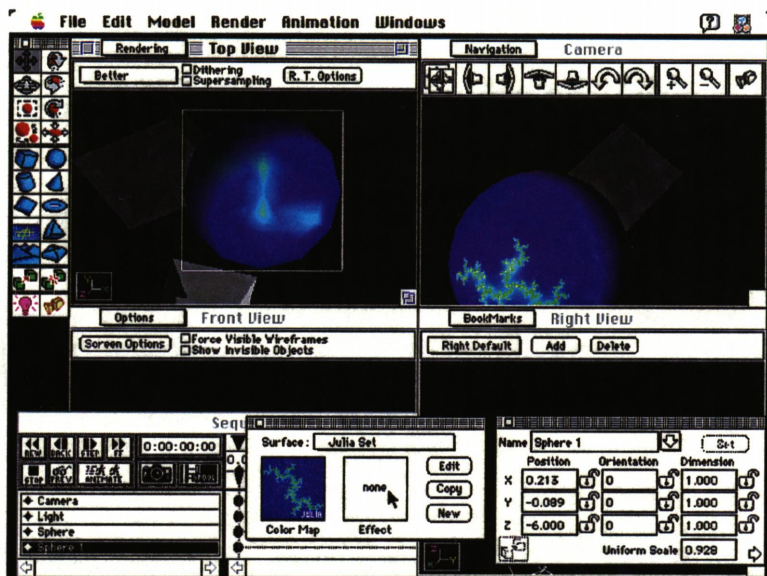
StrataVision 3D was chosen as the primary rendering environment because it allows the most flexible access to shading and rendering attributes and supports the widest variety of object import and image output formats. Strata is a very sophisticated modeling and rendering environment, allowing objects from several different programs to be combined.

The StrataVision modeling environment is best characterized as awkward. However, the current version 2.0.2 is far better than the previous versions of 1.4.2 or 1.4.3. The version 1.4.3C SRX supports RIB files for Mac RenderMan. The current version 2.0.2 does not support RIB files.

Files can be imported in several formats including StrataVision 3D, DXF, EPS, IGES, MiniCad, PICS (animation), Strata Image or Shape files, Swivel 3D, Super 3D, and Suspended Rendering. With the proper extensions loaded, a combined Strata model can be exported in most of these formats. Rendered images can be saved in PICT or TIFF formats. PICT and EPS files can be imported as templates for 2D profiles of objects and then lathed, extruded, swept, smoothed or faceted.

Strata supports 8 shading modes: wireframe, hidden line, quick shading, flat shading, Gouraud shading, Phong shading, Raytracing and Raydiosity®. Attributes can be customized for anti-aliasing, surface mapping, glowing surfaces, shadows, reflectivity, fog, smooth shading, refraction, and transparency. The program has a library of common textures or custom texture maps may be created for a more realistic effect. Textures can be scanned in and saved in PICT format for PICT based mapping. Strata also supports procedural shaders for even greater realism.

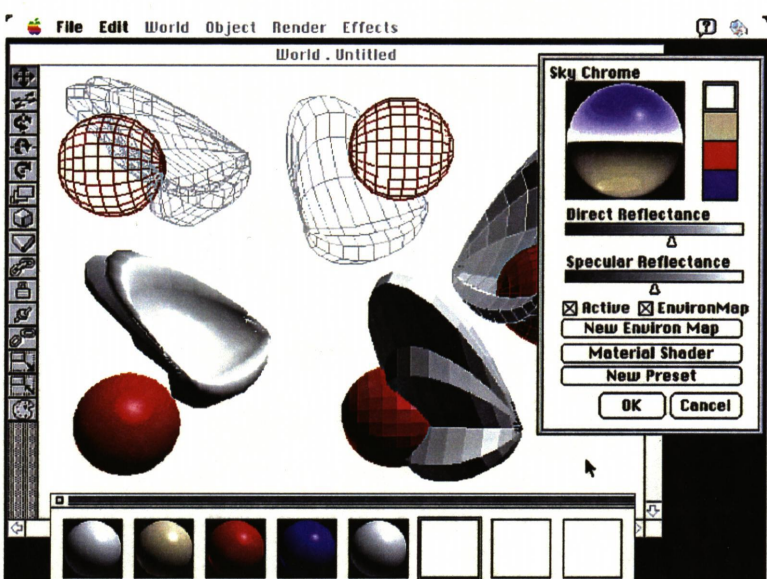
Strata excels at animation. Most 3D programs only allow manipulation of a view, but Strata allows manipulation of all elements in the environment including lights, cameras, and objects. Strata uses the camera analogy to produce an infinite number of perspective views based on the angle of view or the focal length desired. The lights can be global (sunlight), spot lights, or point sources (light bulb). These lights can move totally independent of the objects and the objects themselves can move, change scale, position, or orientation while the camera views continue to change. Animations are saved as individual PICT files or in PICS format. StrataVision 3D includes support for Adobe Photoshop image filters for direct image modification. The "video" filter is helpful in maintaining image quality for images that will be transferred to video tape.



Infini-D 1.1

Infini-D offers almost as much rendering control as StrataVision 3D. However, it lacks the flexibility to import many file types that Strata provides. Currently, only two can be imported: Swivel 3D format and DXF. Normally these two types are enough, but the filters are poorly written and data is often lost in the file translation. Specular is rewriting these filters.

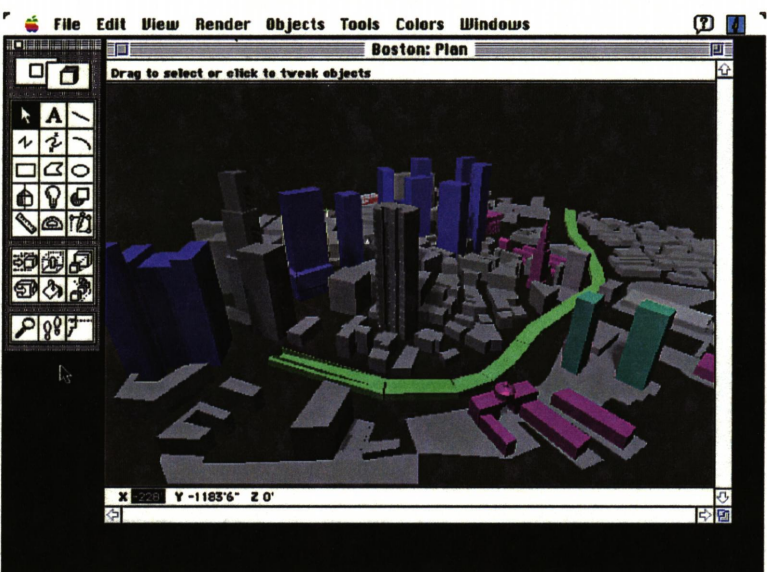
Infini-D supports camera style views like StrataVision 3D. A handy command is provided for pointing the camera at specific objects. Rendering is simple and fast. An attribute library of over 250 textures is included. Infini-D supports full animation and even has object morphing by shape and texture. The animation path can be curved or linear. Swivel 3D key-frame information can also be imported into Infini-D.



Swivel 3D Pro 2.0

Swivel 3D Pro provides a usable interface for object based design. The environment lacks a visible 3D grid, but does provide hierarchical object linking and object based movement for animation. The viewer looks at a single cube of space in which objects are manipulated. A separate environment is provided for object design. The lack of a connection between the modeling space and the object's attributes prevents Swivel 3D Pro from being a truly powerful modeling program.

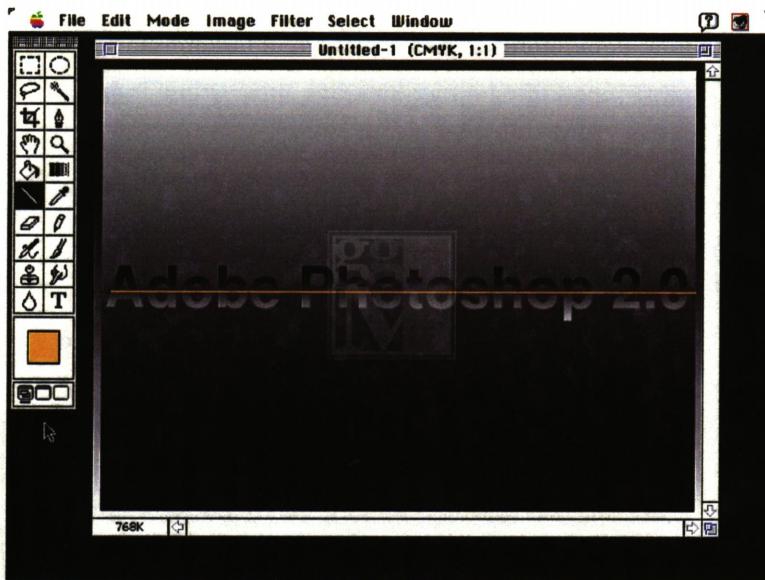
Swivel 3D Pro supports file output in the following formats: MacDraw, PICT, EPS for Adobe Illustrator, Text for Excel, RIB files for Mac RenderMan, and DXF. Swivel 3D Pro supports five simultaneous types of rendering in the same image. More advanced rendering types can include shadows and textures.



ModelShop II 1.1

ModelShop II provides only three default orientations: plan, elevation and axon. Only one of these can be active at a time.

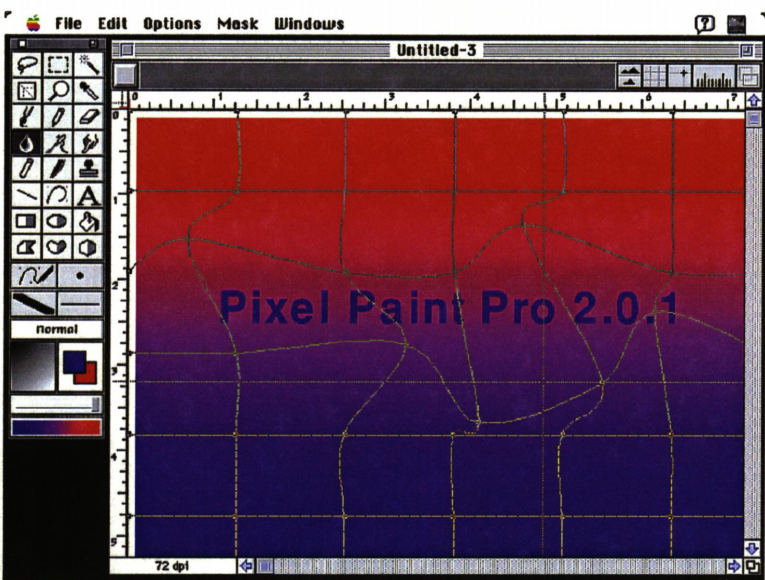
ModelShop II provides the ability to display several simultaneous perspective views and can flat shade these views with shadows using light sources by longitude, latitude and time of day. ModelShop II provides an excellent user defined library function which stores parts for future recall. PICT, Claris CAD, and DXF files import and export into Modelshop II. Swivel 3D Pro file export is also supported. 2D Claris CAD files can be imported and extruded into 3D models. ModelShop includes a handy "fly" tool for directing animations via the arrow keys. Animations can be saved in PICS format. ModelShop II also supports limited device control for output to video.



Adobe PhotoShop 2.0

All images for this book were imported into Adobe PhotoShop 2.0 for final image processing. Adobe PhotoShop 2.0 has full RGB (red, green, and blue) and CMYK (cyan, magenta, yellow, and black) color support as well as monitor calibration for 30 of the most popular monitors and image calibration for 17 professional printers including the Canon CLC 500 used to print this book.

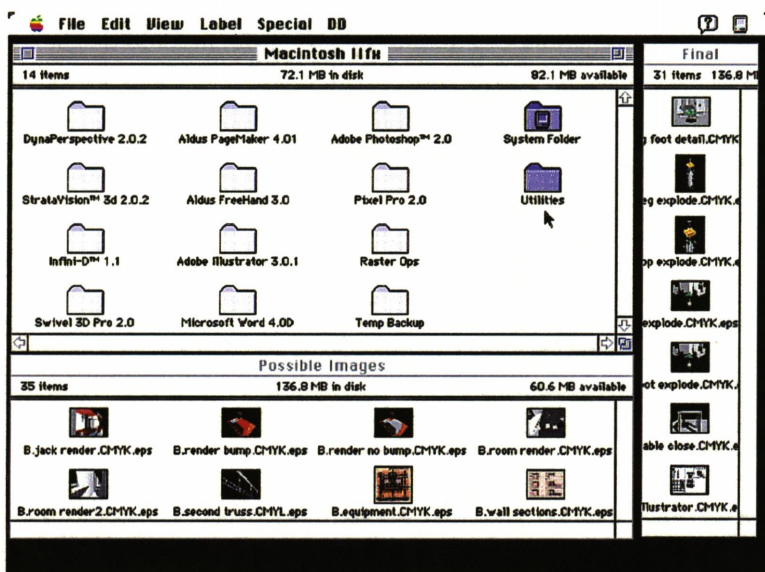
Maximum image size is 416.667 inches by 416.667 inches at 9999.999 pixels per inch. Virtual memory support for Apple System 7.0 allows the manipulation of very large files using hard disk space to page out information. Advanced paste controls allow for transparent layering of images. PhotoShop supports 13 file import and export types including support for the direct display of EPS files.



Pixel Paint Pro 2.0

Pixel Paint Pro 2.0 is an excellent 24 bit paint program, but lacks the flexibility and features of Adobe PhotoShop. Files can be created in one of 13 sizes and resolution must be between 18 and 2,450 pixels per inch. Among the formats supported are HDTV, 12 field and 15 field video, CinemaScope®, and digital film.

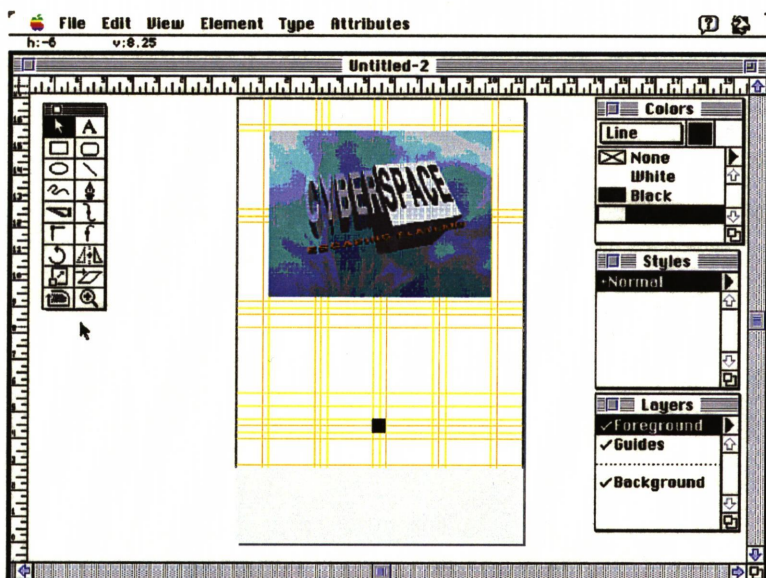
Pixel Paint Pro offers the basic RGB and CMYK color support as well as color support for Pantone® color systems and Color Theory. Controls are included for full color PostScript® file separation. Although Pixel Paint Pro exhibits some great possibilities, it lacks the hardware support necessary to be useful for professional color work to print. Built-in support for the listed video and film formats suggests the true strengths Pixel Paint Pro.



Apple Computer, Inc. System 7.0

Apple Computer, Inc. released system version 7.0 earlier this year. System 7 is a modular operating system allowing for future modules to be added to increase functionality without upgrading the operating system itself.

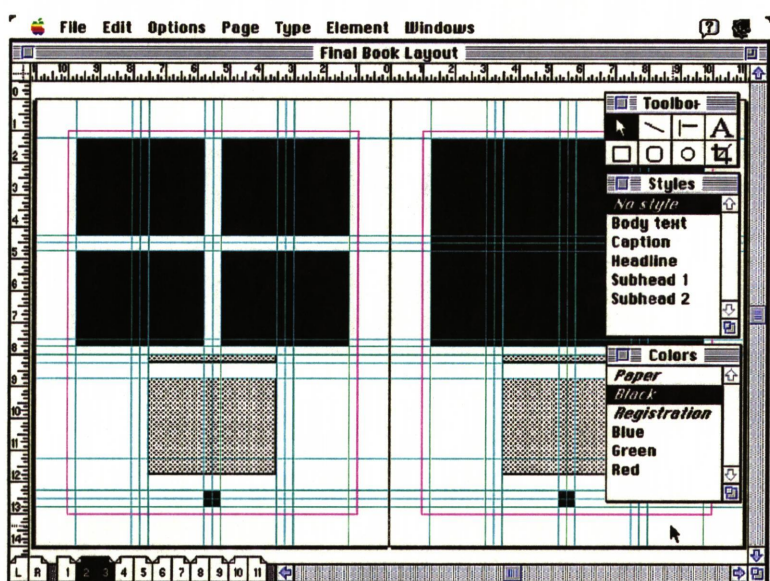
One advantage to this new system is its ability to address over 8MB of RAM (a previous system 6.0.X limitation). Apple System 7.0 also allows the use of free hard disk space as virtual memory, up to 1,280 MB (1 Gigabyte) with 128MB of RAM. Access to this much memory allows the user true multi-tasking. These features, as well as Apple System 7.0 supported PhotoShop preview icons, allowed for the rapid organization and layout of this book. Apple System 7.0 includes driver support for direct PostScript® file output to disk.



Aldus Freehand 3.0

Aldus Freehand 3.0 makes full color desktop publishing possible. Traditional desktop publishing (DTP) is done in black and white and images are subjected to coarse halftone screens. Today, full color desktop publishing is an entirely new and remarkably affordable technology. Professional service bureaus, like Image Center in Roanoke, Virginia, help Mac users take advantage of this technology today.

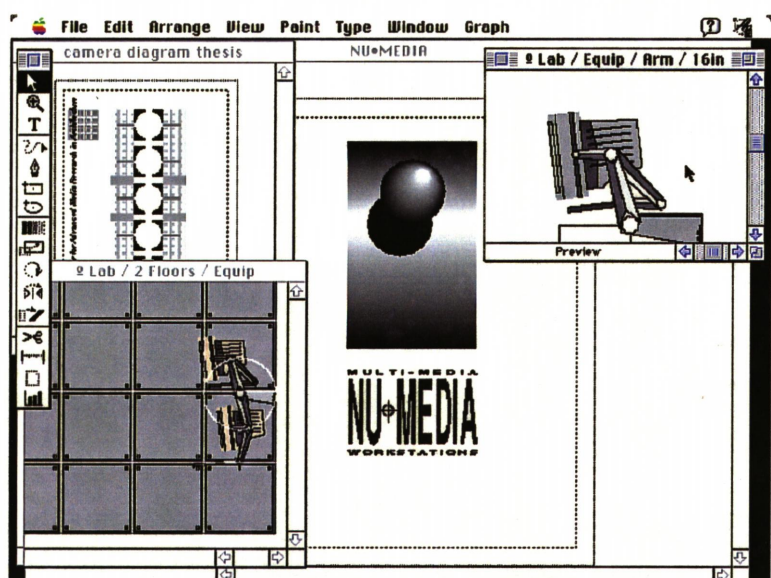
Aldus Freehand provides support for over 40 professional printers at resolutions from 300 to 2,540 dots per inch. Aldus Freehand is one of the few applications that allows control of CMYK (cyan, magenta, yellow and black) images in EPS format for complete desktop separations to film or direct PostScript® file output. Freehand also supports Pantone® Professional color matching systems.



Aldus PageMaker 4.0.1

Aldus PageMaker has dominated the desktop publishing (DTP) industry for almost seven years. Though it has the look and feel of a major DTP program, it has no real power. Therefore, a very small percentage of the publishing industry currently uses Aldus PageMaker. Even when combined with Aldus Preprint for color separations, Aldus Pagemaker still cannot keep pace with programs like QuarkXPress.

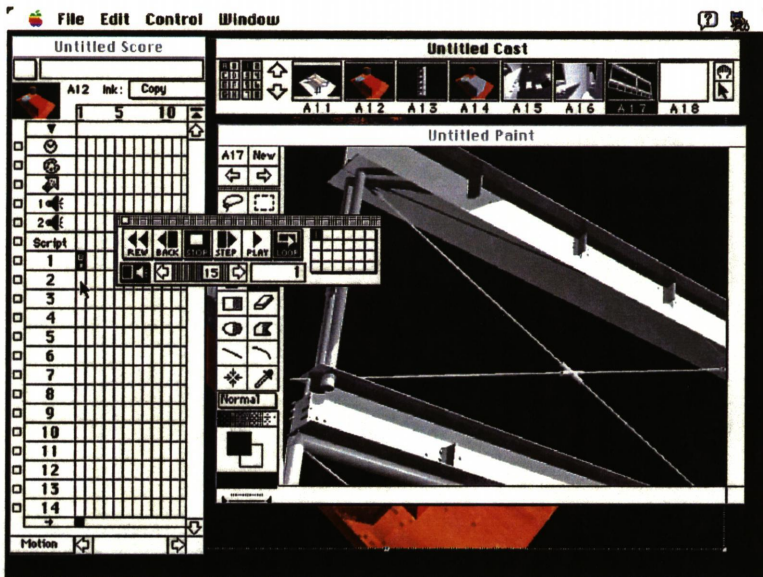
Unlike Aldus Freehand, it does have the ability to layout large multi-page documents (999 pages maximum). Image control is provided for imported TIFF images, but EPS images are shown by bounding box only. Version 4.0.1 supports Apple System 7 publish and subscribe features for linking the images to the actual page layout and updating the layout if the images are changed.



Adobe Illustrator 3.01

Adobe Illustrator has proven to be one of the most versatile programs. Illustrator can output files in EPS format to be used as a 2D profile in StrataVision 3D. Illustrator will import 1 bit PICT images and convert them into high-resolution EPS files. This is extremely useful for creating high-resolution topo maps. The line drawings can then be exported in EPS format to Adobe PhotoShop where they can be combined with various other image types and then output from PhotoShop.

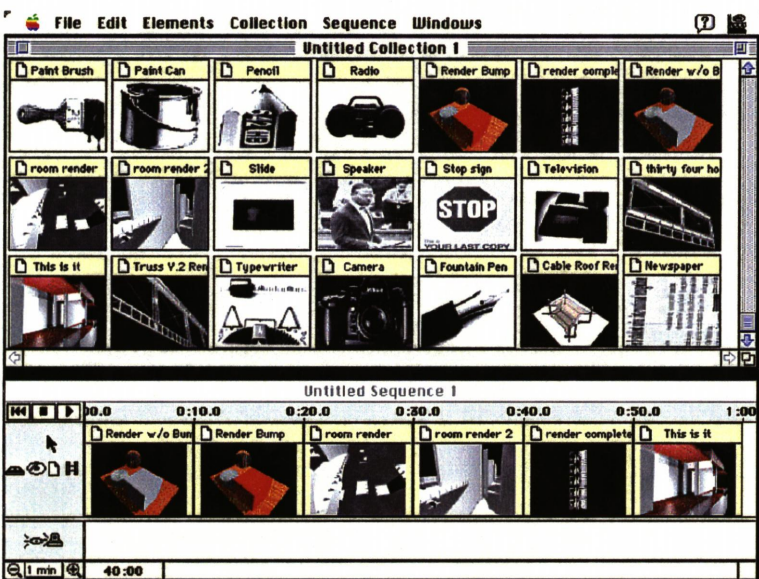
Swivel 3D Pro saves rendered models in Adobe Illustrator 88 format that Illustrator 3.0 can read and display. These images have the advantage of printer independent resolution for output over 36,000 lines per inch. Illustrator is also perfect for creating high resolution 2D diagrams and drawings.



MacroMind Director 3.0

MacroMind Director 3.0 is the industry standard 2D animation and interactive authoring environment for the Macintosh. Director supports PICT and PICS image file import. Most 3D animation programs convert 3D modeling information to 2D images that can be used by programs like MacroMind Director 3.0 and MediaMaker for output to video.

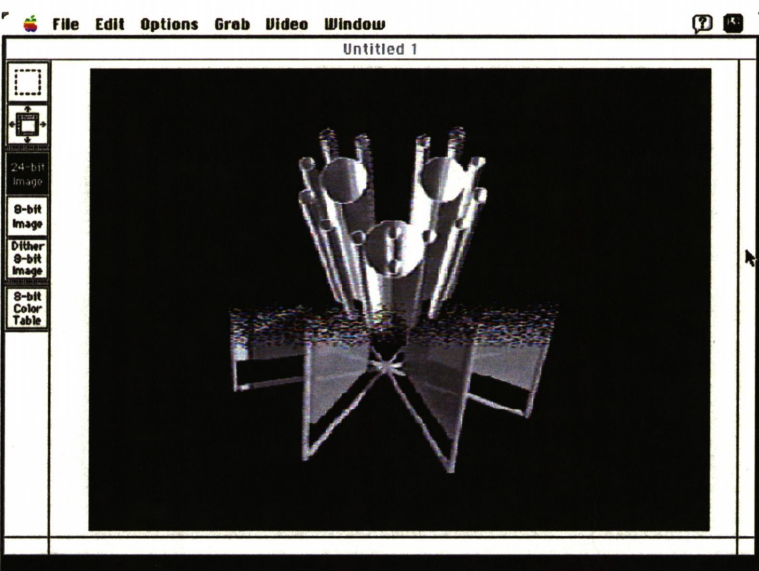
Large animation file can be output one frame at a time to video via professional video decks using SMPTE time code and device controllers. One full screen 24 bit (16.7 million colors) image is 900k (640 by 480 at 72 pixels per inch) and an 8 bit (256 colors) image is 300k. MacroMind Director 3.0 also includes very sophisticated interactive authoring tools for the development of computer based applications and presentations.



MacroMind Media Maker 1.2

MediaMaker has done for computer based video what the laser printer did for desktop publishing. Media Maker provides a computer based interface between graphics, animation, sound, and video. MediaMaker features full video device control for most major commercial and consumer video decks and camcorders. MediaMaker's "print to video" command has revolutionized the creation, editing and management of video and computer based media.

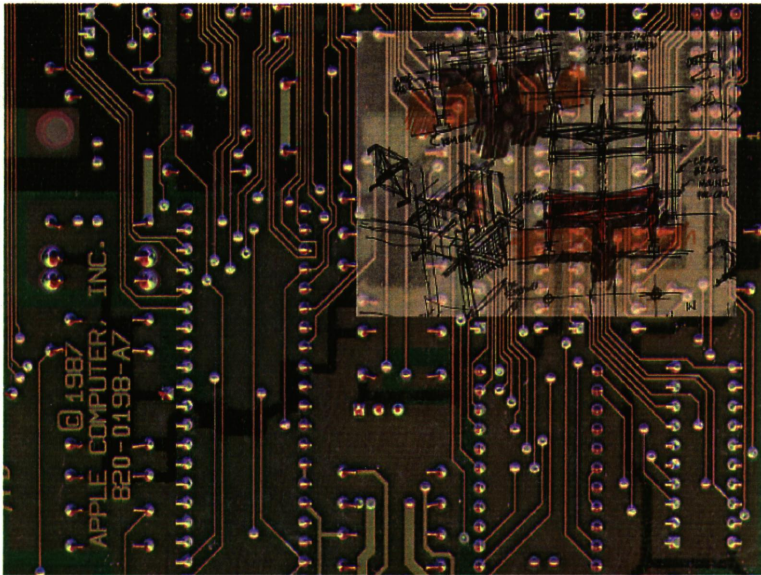
Device control is made possible directly from the Macintosh printer and modem (serial) ports. Only a cable is needed to interface between the Mac and devices that support "CONTROL-S" and "LANC" control protocols. MediaMaker imports Macintosh graphics in PICT and PICS format and supports Chroma-keying for video overlay.



Raster Ops Frame Grabber

The Raster Ops Frame Grabber utility is included with every Raster Ops NTSC capable video board. The utility allows for resizable windows, displaying live full frame video, to be played on the Macintosh desktop. Video images can be "captured" (digitized) and converted to Macintosh image files. Consecutive frames of live video can be captured and saved as individual PICT or PICS animation files. PICS files can be played back to simulate Digital Video (a current emerging technology of saving and storing video images as computer files).

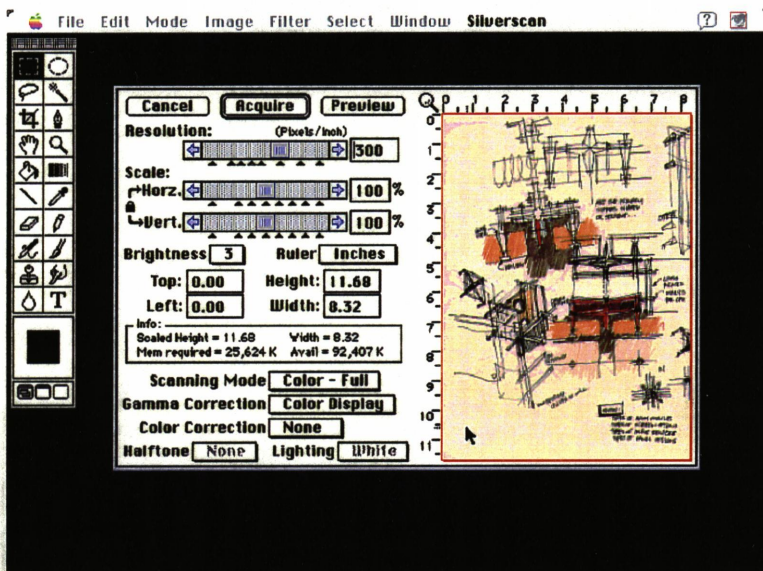
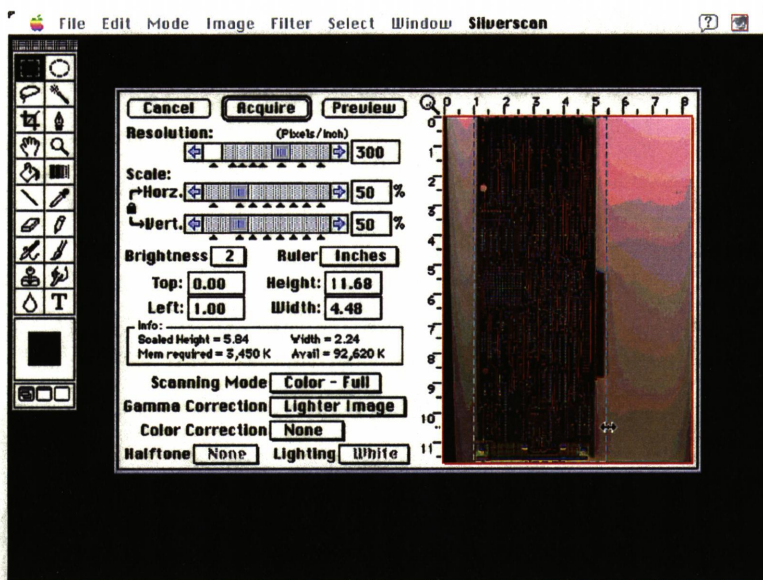
The Raster Ops video board is also useful for capturing textures of objects to be used in StrataVision 3D for image mapping or for use as backgrounds in Adobe PhotoShop, MacroMind Director, and MacroMind MediaMaker.

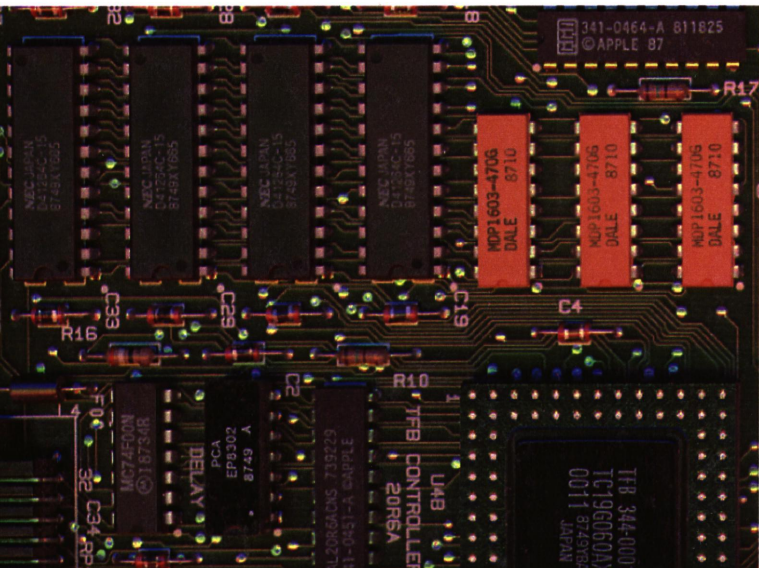
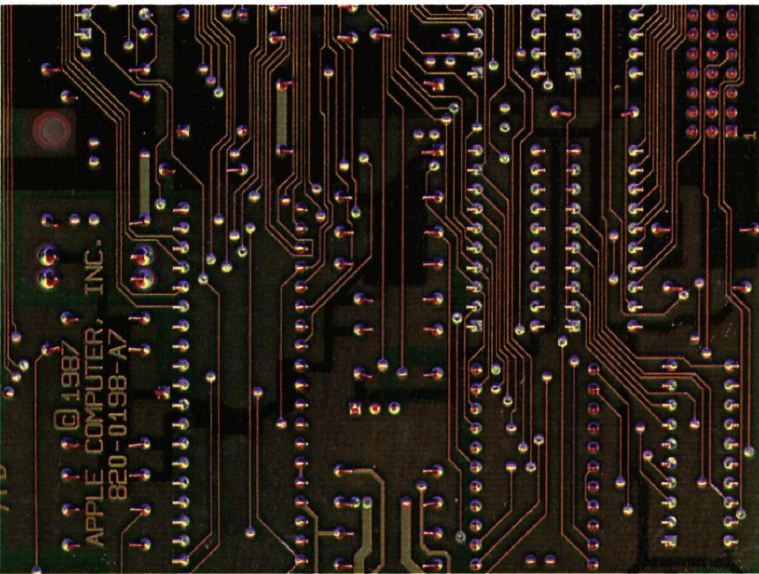
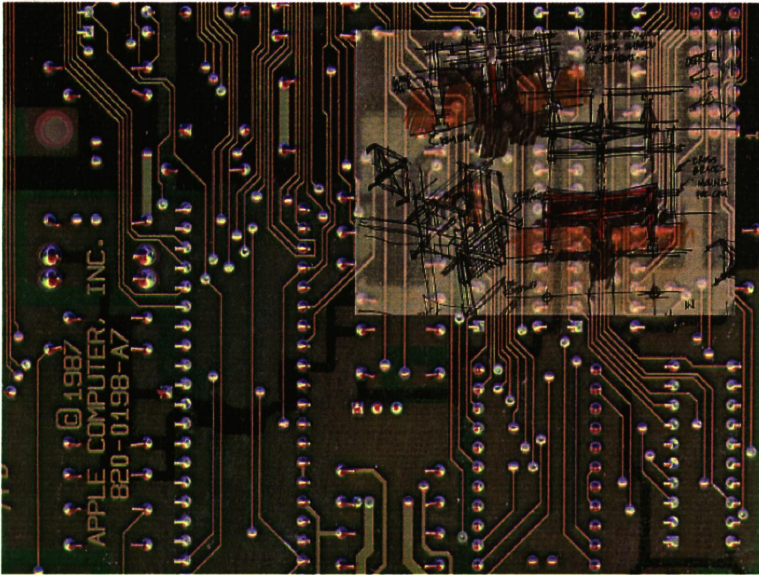


LaCie SilverScan

SilverScan is LaCie's popular scanning software for use on the LaCie color scanner. The scanner scans images in 24 bit color, 8 bit grayscale, and 1 bit modes. The LaCie scanner is one of the few scanners on the market that can be used with the Macintosh that supports 1,200 dot per inch (dpi) scanning in line art mode and 600 dpi in full color mode. The only limitation of the LaCie scanner is that no image larger than 8.5 x 11.5 inches can be scanned. Most other scanners support scans as large as 8.5 x 14 inches or even 11 x 17 inches. However, what is lost in size is gained back threefold in image resolution.

The LaCie scanner can be accessed directly through the most popular image processing software packages like Adobe PhotoShop, Digital DarkRoom, ImageStudio and Color Studio. The LaCie scanner can be used to scan drawings and sketches directly into the computer. Scans can then be used as templates in programs like Claris CAD, Adobe Illustrator, and StrataVision 3D. Images can be scanned from photographs, books or magazines--almost anything that will lie flat on the scanner's glass plate. Textures from real world objects can be scanned and used as textures in programs like StrataVision 3D. Image composition and document layout can be achieved through the use of image processing packages.





"The Jury's Still Out"

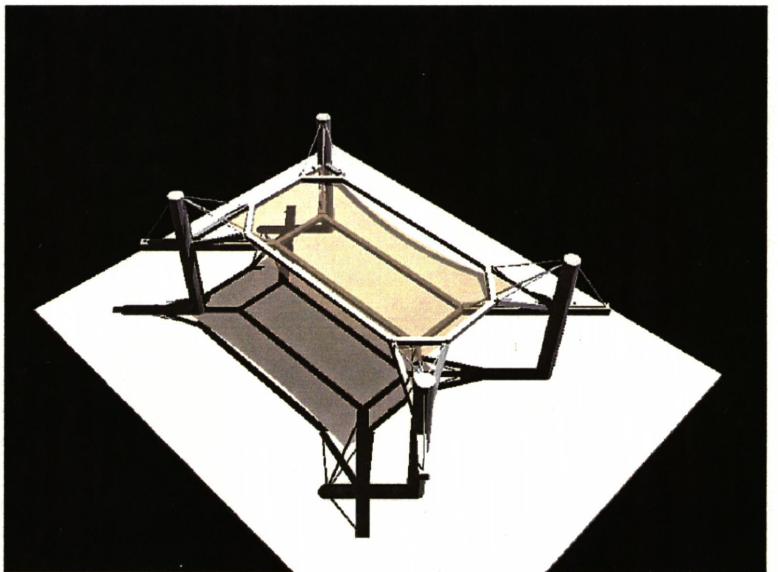
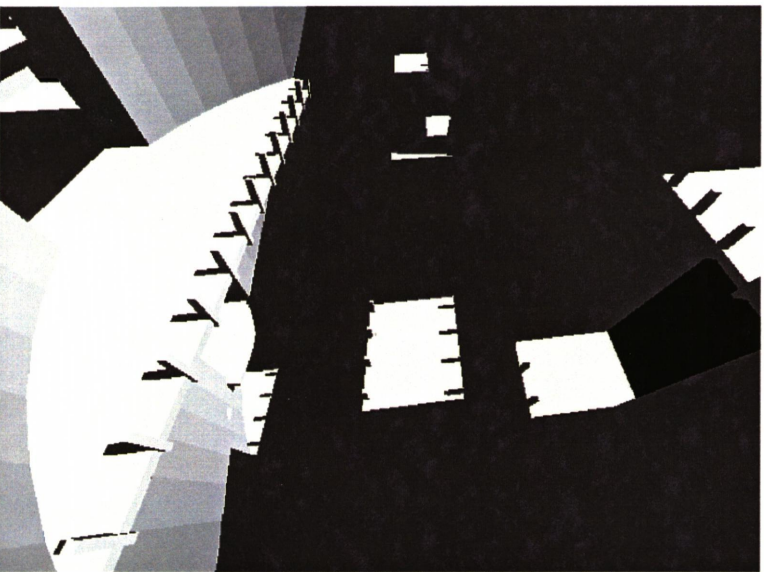
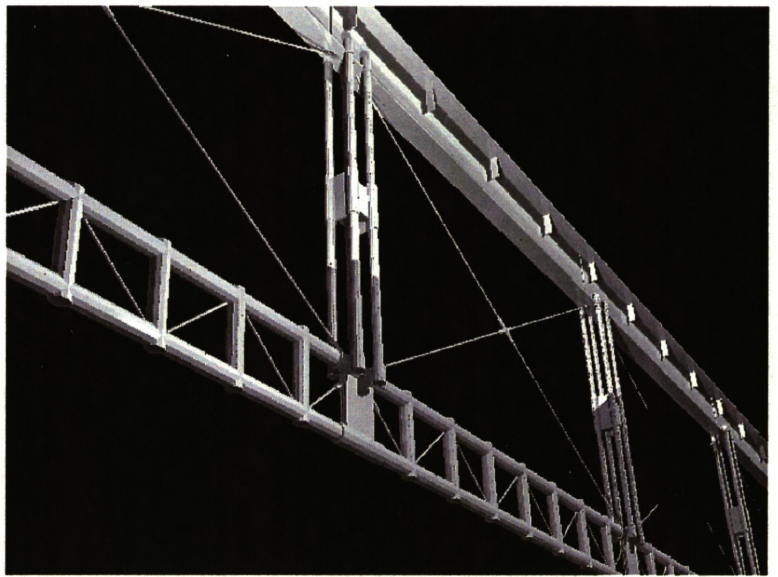
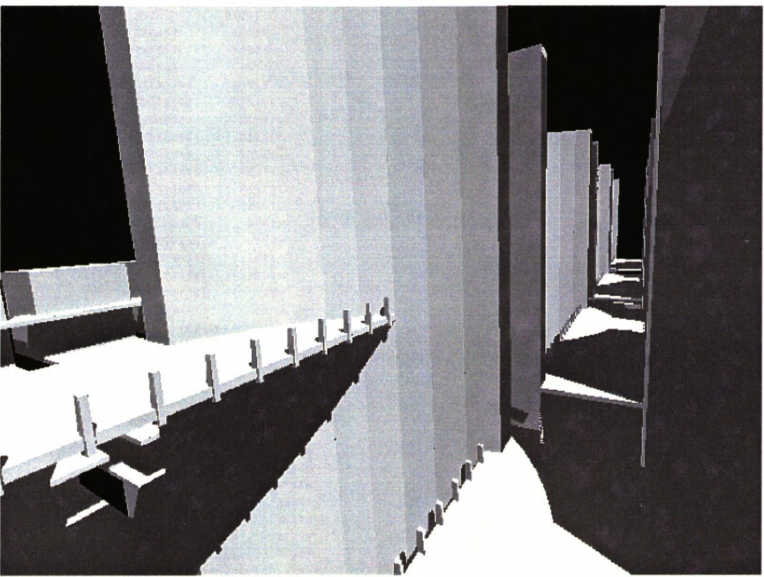
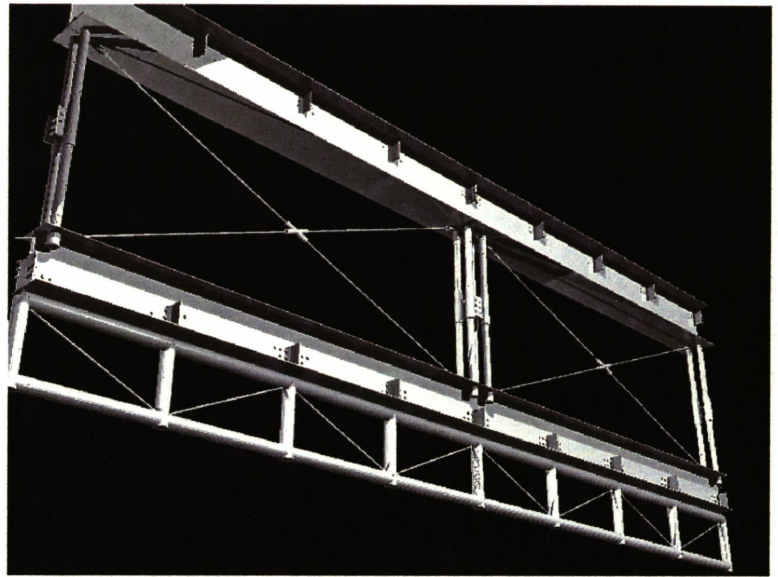
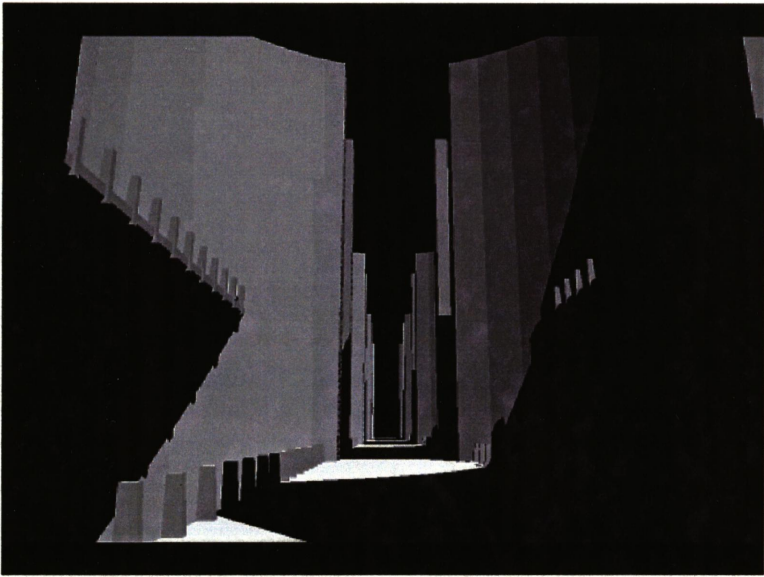
Real time three dimensional computer aided design (CAD) is closer to becoming reality. Technology is doubling if not tripling the capability of users every one to two years. The emergence of new untested methods of design are slow to become accepted by mainstream professionals of the design community. For too many years professionals have relied on computers to mimic the manual process which has dominated the architectural profession for hundreds of years. The design community will not see true progress in the area of computer aided design until it realizes that the "D" in "C.A.D." stands for "design" and not "drafting."

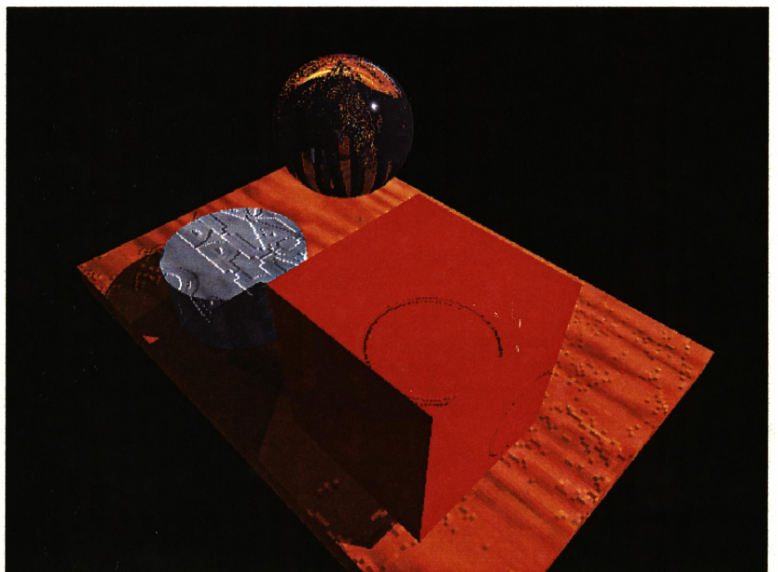
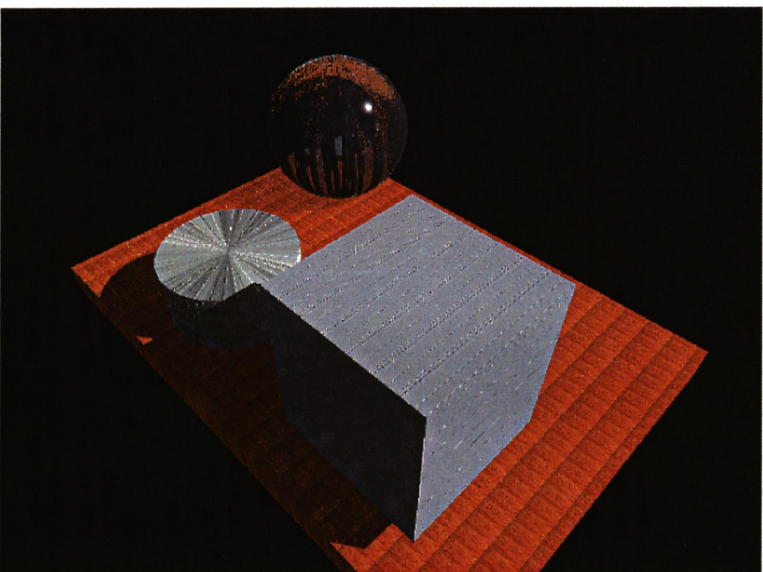
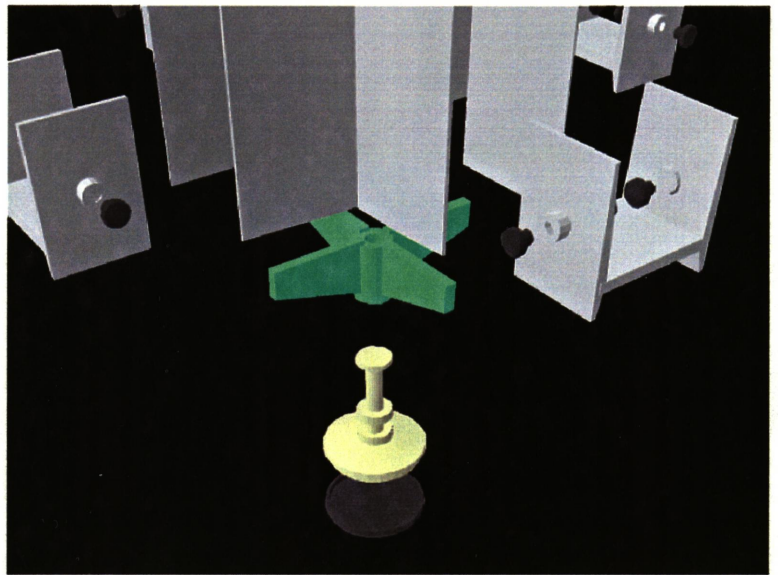
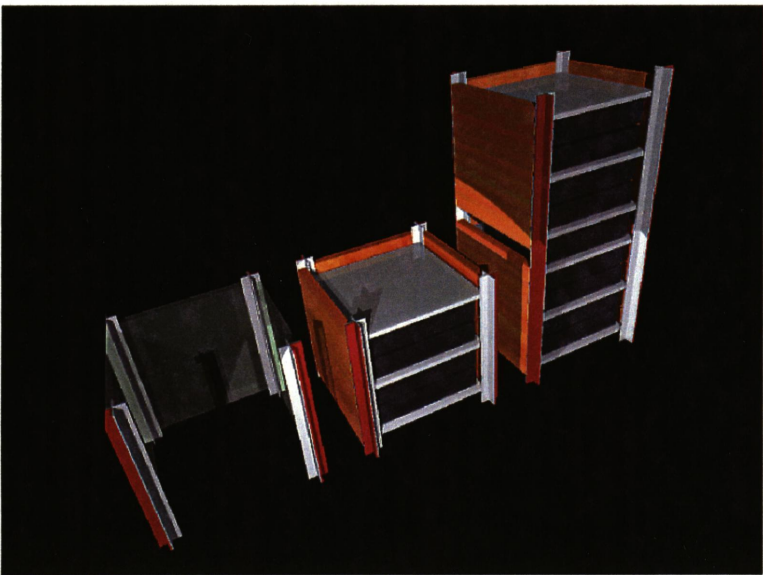
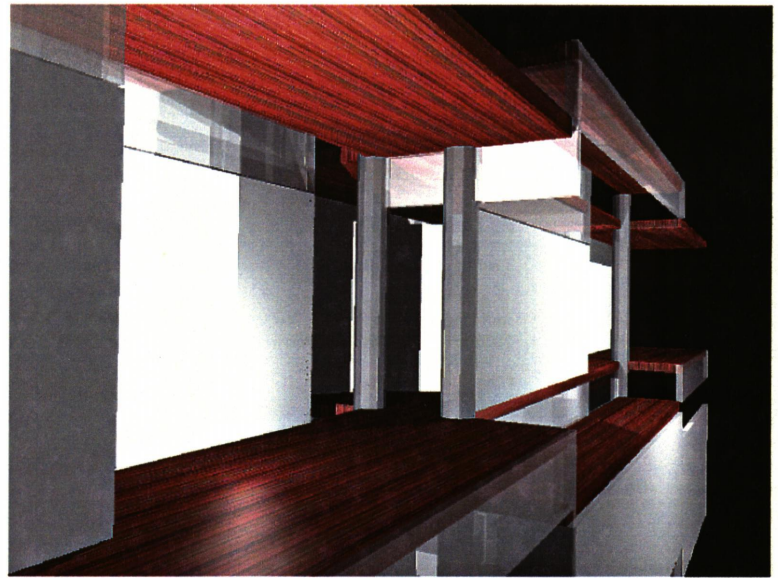
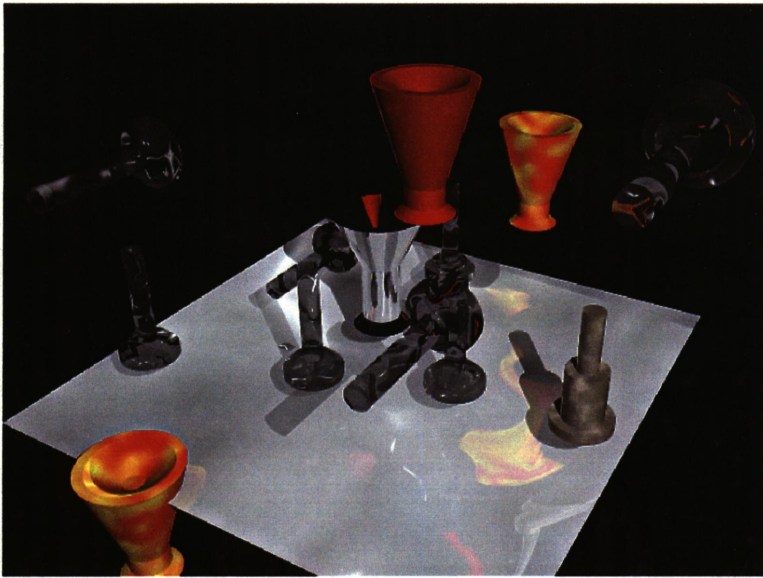
The technology of full 3D computer aided design still has a long way to go before it can be implemented in a broader sense. Redraw and rendering times are still too slow to be of any real use in interactive design. The feedback that an architect receives from dragging a pencil across a piece of paper is still faster. Soon, however, rendering times will be measured in terms of seconds and not hours (or days).

Technology aside, formal considerations deserve attention. Working in 3D allows immediate spatial manipulation at the expense of diagrams or plans. The plan has been a convenient orienting device for hundreds of years. Architects are able to extrapolate data from plans that may be merely implied. The architectural community will have difficulty adapting to this new way designing. Universities need to provide students with manual and computer skills so that graduates will be prepared to handle the transitional period that lies ahead.

The computer program imposes often unwanted constraints on object design and manipulation that inexperienced users may not anticipate and that experienced users may not accept. Choose a computer program carefully; try them all and then decide. NEVER use only one program. Always invest in the most recent versions of all programs; upgrades often include many subtle but powerful changes that may greatly improve the design process.

The computer has allowed architects to automate many tasks traditionally accomplished by hand. The ever increasing speed with which the computer can accomplish these tasks forces architects to determine what role the computer will play in the design process. I believe that we have an obligation to ourselves to use the computer responsibly. The computer should supplement and aid our abilities--not automatically determine or specify the nature of the design. The temptation will be to allow the computer to "generate" designs based on minimum standards. This would lead to the ultimate elimination of the need for architects and design. Instead, designers should use the computer to challenge, refine, and develop architecture in order to dramatically effect the quality of design.





CYBERSPACE

ESCAPING FLATLAND

A STUDY OF DESIGN IN THE VIRTUAL
ENVIRONMENT

RESOURCES

Computers and Cybernetics

B.H. Rudall, Abacus Press, Kent, 1981

Cybernetics

W. Ross Ashby, Wiley and Sons, Inc. New York, 1966

The Electronic Design Studio

McCullough, Mitchell, and Purcell, ed., MIT, 1991

Real World Freehand 3

Olav Martin Kvern, Peach Pitt Press, 1991

Barnhart Dictionary of Etymology

Barnhart Press, 1988

MacWorld & MacUser Magazines

Serving the Personal Macintosh Industry (monthly)

New Media Magazine

Serving the Professional MultiMedia Industry
(bi-monthly)

Image Center

Serving the Desktop Publishing Industry.

The pages of this book were produced entirely on a Macintosh IIx with 20MB of RAM, 160MB internal hard drive, 80MB external hard drive, 210MB external hard drive and 45MB removable SyQuest cartridges. The final pages were output as Postscript® files directly to disk using Aldus Freehand 3.0, the Freedom of the Press Professional ADP and Apple® System 6.0.7. The Postscript Files were rasterized on a Canon CLC 500 via Macintosh raster image processing interface. The maximum file size allowed is 24MB. The Canon CLC500 prints at 400 dots per inch using a dye sublimation process for photorealistic continuous tone color images.

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