Production Design Department
AMERICAN FILM INSTITUTE
Los Angeles, California

Ancient Principles Inform 3D Production Design

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form·Z FOR FILM

The American Film Institute Conservatory is an accredited 2-year MFA program granting a degree in Film Production Design, as well as the areas of producing, directing, writing, editing and cinematography.

AFI production design fellows are actively involved in making student films throughout their time at AFI. In addition to their other academic studies, in second year they receive a one year course in 3D computer design for film using **form·Z**. This course is a 3D computer design practicum for film production design purposes, using classical architecture to illustrate the principles of design. Additional emphasis is placed on specific film production design conventions and techniques.

HOLLYWOOD TRAINS ON form·Z

We utilize **form·Z** for 3D modeling of our film sets, rendering for conceptual presentation and keyframe illustration, 2D drafting for set construction documents, and animation both to explore a set spatially and to present the set as a specific film camera will see it to the director and producer.

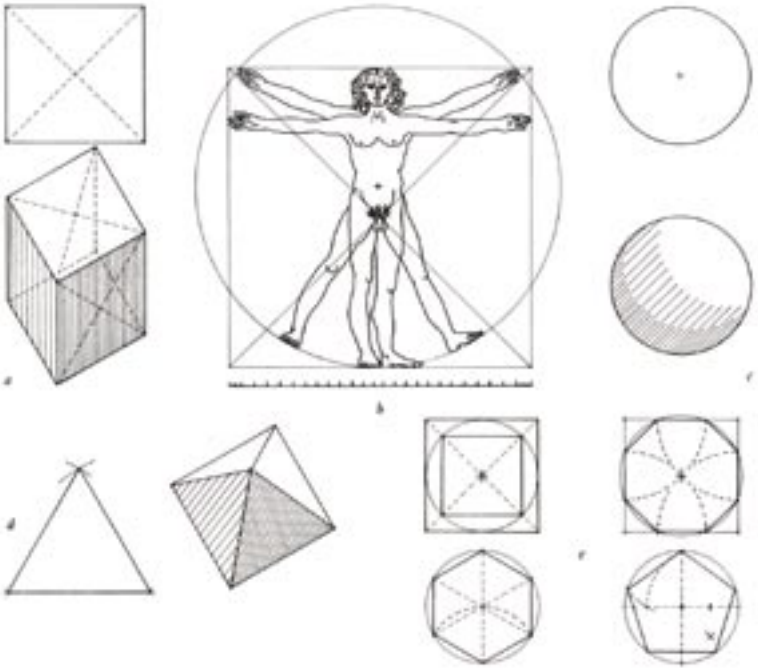
As a laboratory exercise text, we use Lachmi Khemlani's excellent book "**form·Z** 4 - 3D modeling, rendering & animation". Her book provides in-depth explanations and step-by-step instructions for the students to follow, at their own pace, for their lab time.

During the hands-on class time we begin with a 3-wall "sit-com" set and learn floorplan layout techniques, extrusion to height, and examine the Boolean tools in order to place accurate windows and doors. The sweep tool creates cornice, chair, base, door and window moldings, while the 2D derivative tool forms accurate window mullions.

This 3-wall set is used to render hidden line projections and descriptive perspective views for simple drafted documents. We further analyze in 2D, human scale, proportion, film conventions of sheet layout, dimensioning, labeling, and title block.

PROPORTION AND A WORLD WITHIN A WORLD

Our next exercise involves the investigation of ancient classical Greek proportion and proportional systems. Drawing from Robert Adams' "Classical Architecture", (1991), we experiment in 2D with rectangular proportions, both arithmetic and geometric for the purpose of design layout in plan and elevation.



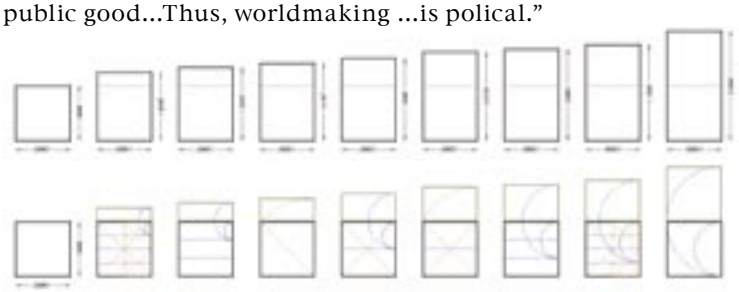
Proportion is crucial to design, and knowledge of how architecture has used proportional systems in the past can ground a designer in fertile territory from which to make creative and intelligent decisions.

F.D.K. Ching states in "Form, Space, and Order", (1996), "Mathematical systems of proportion originate from the Pythagorean concept of 'all is number' and the belief that certain numerical relationships manifest the harmonic structure of the universe."

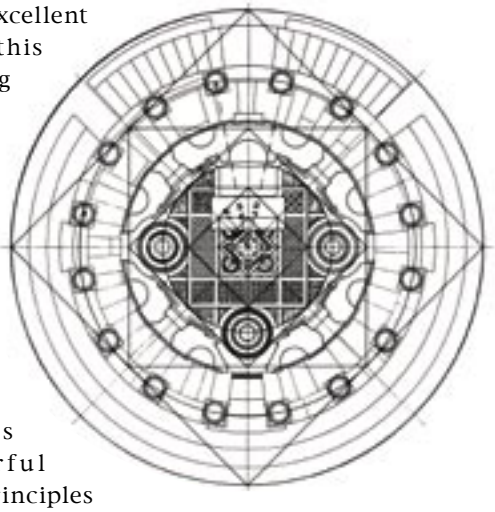
Today this mathematical connection underlying conceptual design also underlies the functioning of the computer as tool, and software as instrument, to manifest computer design work.

A. Tzonis and L. Lefaivre in "Classical Architecture", (1988), posit that "Every classical work is...cut out from the rest of the universe by virtue of its special order. To fashion this work is to make a world within the world.

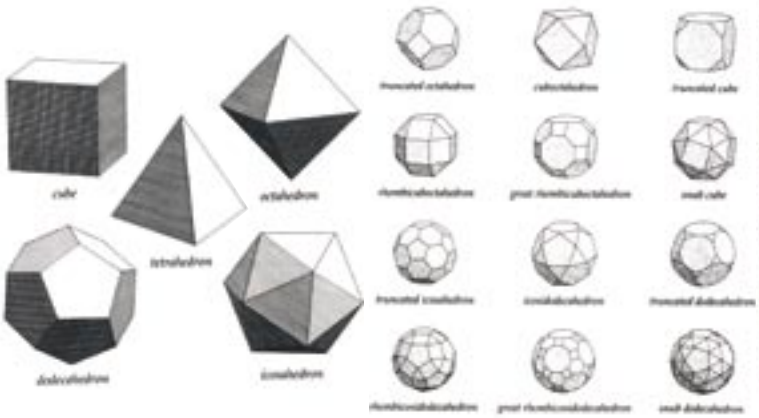
"The purpose of this world-making...is to instruct and persuade... The work should affect the minds of the audience for the sake of public good...Thus, worldmaking ...is polical."



We begin with simple arithmetic proportions based on the circle and the square, and move to the complex proportions of root-two, root-three, root-five rectangles, along with the mysterious Golden Section (phi Ø), Golden Rectangle and the Fibonacci sequence. We draw and find the relationships in the intensely geometric Ad Quadratum, Ad Triangulum, and the Sacred Cut. Regulating Lines that are parallel or perpendicular are introduced as a means of determining whether two rectangles have similar proportions. Using **form·Z** in 2D is an excellent way to both cover this material in an exciting fashion as well as gain experience with the drafting tools and the incredible accuracy in drawing simple and complex constructions.



Taking exercises from the wonderful M.W. Jones book "Principles of Roman Architecture", (2000), combined with D. Sutton's concise "Platonic and Archimedean Solids", (2002), we travel back in time to uncover the ancient, underlying foundation of the Western sense of proportion and balanced design.



All of this takes place while learning to use the 2D drawing tools, underlays, importing and viewing images (scans), drawing with object snaps and labeling with the text and dimension tools.

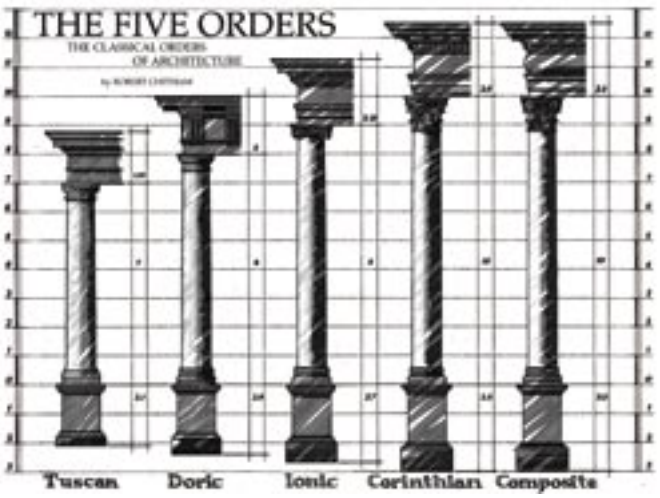
VITRUVIUS AND THE ORDERS

The 5 Orders of Architecture are the next destination in our study of proportion. F.D.K. Ching (ibid.) summarizes, "To the Greeks and Romans of classical antiquity, the Orders represented in their proportioning of elements the perfect expression of beauty and harmony. The basic unit of dimension was the diameter of the column. From this module were derived the dimensions of the shaft, the capital, as well as the pedestal below and the entablature above, down to the smallest detail. Intercolumniation–the system of spacing between columns–was also based on the diameter of the column."

We discuss Vitruvius, who in the time of Augustus, wrote the first treatise on the Orders, "Ten Books on Architecture", and the great renaissance theorist-designers who, in writing their own tracts on architecture, emulated his landmark work, Alberti (c. 1450), Serlio (1540 – the first published drawing and comparison of the Orders), Vignola (1563), Palladio (1570), Scamozzi (1615), Perrault (1676).

This leads us to use the exquisitely drawn R. Chitham book, "The Classical Orders of Architecture", (1985) to model a Doric column complete with pedestal and entablature. This exercise in **form·Z** allows us to examine the "tripartite" (rule of three): proportion regarding an architectural element (as opposed to space), lines of symmetry and axis, and human scale. We learn to use the revolve tool, of course, in creating the column and moldings.

Hidden line renders capture the column in projection and perspective views which we transfer into 2D drafted form to review the drafting procedure.



NATURE AND GEOMETRY

Our next exercise is to follow in the footsteps of the founding designer of the Baroque, Borromini, using Anthony Blunt as our guide. His book "Borromini", (1979), gives us this wonderful summary of the Renaissance design process. "There is, however, a third authority to which Borromini appeals in addition to Michelangelo and the Ancients, namely Nature.

"With Alberti the theory that architecture imitates nature was combined with the Aristotelian idea that nature is based on laws,...Often the harmony underlying nature is associated with the idea of mathematics, either with the Platonic idea that nature is composed of the five regular solids, or with the Pythagorean belief in the eternal value of numerical relations. For Palladio the true proportions of a building were based on certain simple arithmetical relations derived from musical harmony. For Alberti and others the connection was rather with geometry..."

"...a fundamental feature in Borromini's method of working was] the fact that he evolved even his most complex and apparently whimsical designs by a series of geometrical manipulation. It has often been pointed out that the plans of S. Carlo alle Quattro Fontane and S. Ivo are based on a series of triangles and circles, but it has not always been sufficiently emphasized that they were actually created out of these geometrical figures."

With this in mind we work on top of Borromini's sectional drawing of the molding of door to cloister at S. Carlo alle Quattro Fontane, Rome, 1665. A. Blunt relates, "A section of the cornice given in an early eighteenth-century engraving shows the system on which the mouldings were based. The whole cornice is enclosed within a square ABCD. The side AD is divided into halves and quarters at F and E. These give J and G at the points a quarter and half way along the diagonal AC, which mark the main breaks in the moulding. The lower half of the moulding depends on the proportions of 1:2 and 1:3. For instance, the radius of the arc JP is one sixth the side of the square, and the same radius is used for the arcs PO and NM. A circle of double this radius, i.e. one third of the side of the square, runs through the points J, O, N, L. The lengths of LS, SM and SQ are all equal, and the arc LQ has a radius of one twelfth of the side of the square. Finally, all the crucial points in the moulding – G, J, L, Q and R – lie on the diagonal AC."

This complex molding not only shows us the sophisticated use of geometry as a practical aid to design. It also makes for a delightfully elegant use of the vector and arc tools to reproduce in one flowing expression the layout of an important piece of architecture. We perform this in the modeling environment to create a smooth source shape to use with the sweep tool to create a 3D door molding.

BRAMANTE INNOVATES

Our next project is to return to the High Renaissance in the company of Donato Bramante. In John Summerson's "The Classical Language of Architecture", (1993), he relates, "It was he, more than anyone else, who re-established the grammar of ancient Rome in buildings of pre-emminent consequence...Everybody recognized his authority." Serlio wrote that he was the man who revived the buried architecture of antiquity; and Serlio paid Bramante an even greater tribute when he included some of his works in the part of his book ostensibly devoted entirely to ancient Rome. For Serlio, Bramante was the exact equivalent of the antique.

"This Tempietto is a perfect piece of architectural prose–a statement, clear as a bell." The Tempietto is the progenitor of all 'capitol' domes throughout the Western world including those of church architecture at St. Peter's, Rome, St. Paul's, London and the Pantheon, Paris.

As such a seminal work, and because of its limited scale and precise proportion and detailing, the Tempietto makes an excellent 3D modeling project. We employ our previously modeled Doric column in a full building context and utilize the revolve tool repeatedly to create the elements of the Tempietto which are rigorously aligned to its central vertical axis in keeping with its primary function as a martyrium.

ANNIE CAMPOS

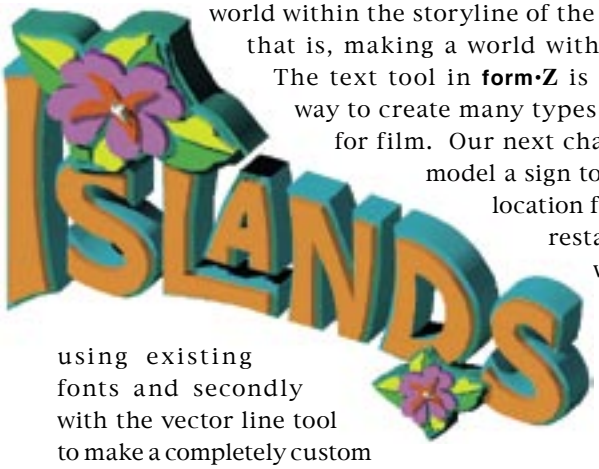
We proceed with the 3D model and use it for authentic texture mapping, lighting and studies of composition within the camera's frame, as well as its drafted presentation.

The Tempietto and its courtyard is a centrally designed building that is radially symmetrical and this introduces the concept of radial layout in plan, as opposed to the more common rectilinear organization. Students must divide the plan in an angular manner to copy rotate elements into correct position.

As an advanced exercise, students are encouraged to finish Bramante's original design for the surrounding courtyard of the Tempietto which was never completed. We will return to our model of the Tempietto later on and use it again for animation studies.

SIGNS AND GRAPHICS

Creating signs and graphic logos is an integral part of film production design for the purpose of creating a believable world within the storyline of the screenplay, that is, making a world within a world. The text tool in **form·Z** is a powerful way to create many types of 3D signs for film. Our next challenge is to model a sign to be used on location for a specific restaurant, first with the text tool using existing fonts and secondly with the vector line tool to make a completely custom letter style. Lighting the sign, illuminating it as neon and texture mapping follow.

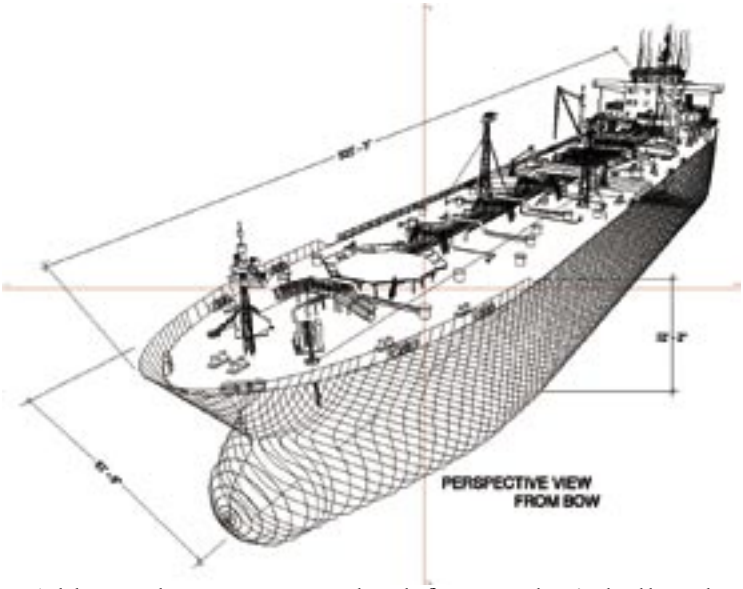


BOROMINI GEOMETRY AND LOFTING

We return to Borromini's work on St. Ivo della Sapienza, Rome, 1643, for an examination of his complex geometrical layout for the plan of this landmark building. A. Blunt (ibid.) describes it, "The general design is of extreme ingenuity, and in it Borromini brought to full maturity the ideas with which he had been experimenting..."

The plan is based on two equilateral triangles which interpenetrate to form a six-sided star on the outer periphery and a regular hexagon as the central space.

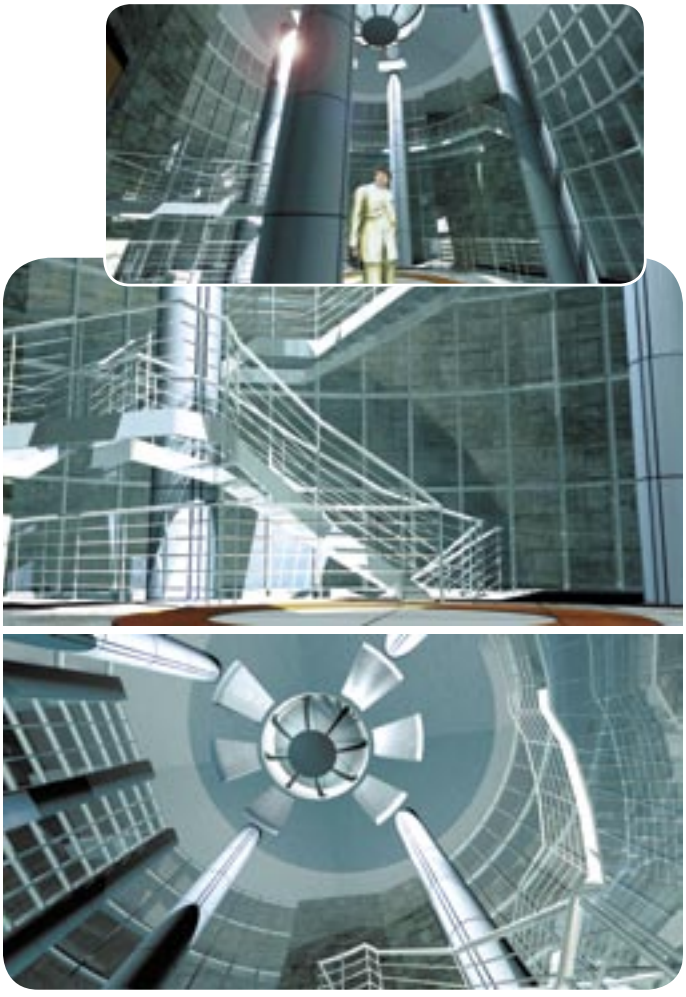
We construct this plan outline in 2D first, to rapidly lay out the underlying geometry and then, the plan. Distilling the non-repeating axial elements and centerpoints we transfer it to the modeling window where we will create a smooth compound curve with which to extrude the walls, sweep the entablature and loft the dome of S. Ivo. Texture mapping an image of the inner dome to the lofting gives us a good conceptualization of the complex space.



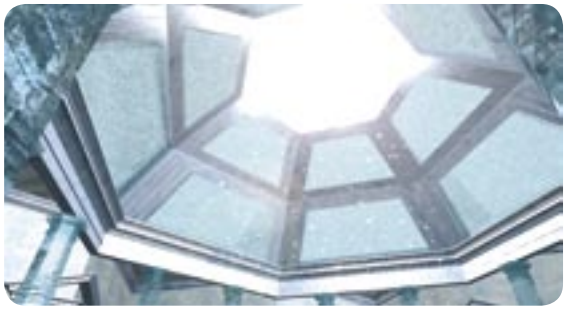
Additional exercises involve lofting a ship's hull and examining the integrity and "fairness" of the surface.

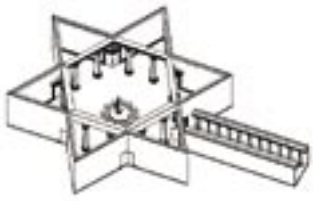
THE FINAL FRAME

The last part of the second semester is devoted to the fellow's Final Project, where they select a film script and create an original design for one or more sets. Finished renderings and animations are the end result, presented to the entire Institute at end of term, and for use in their portfolios.



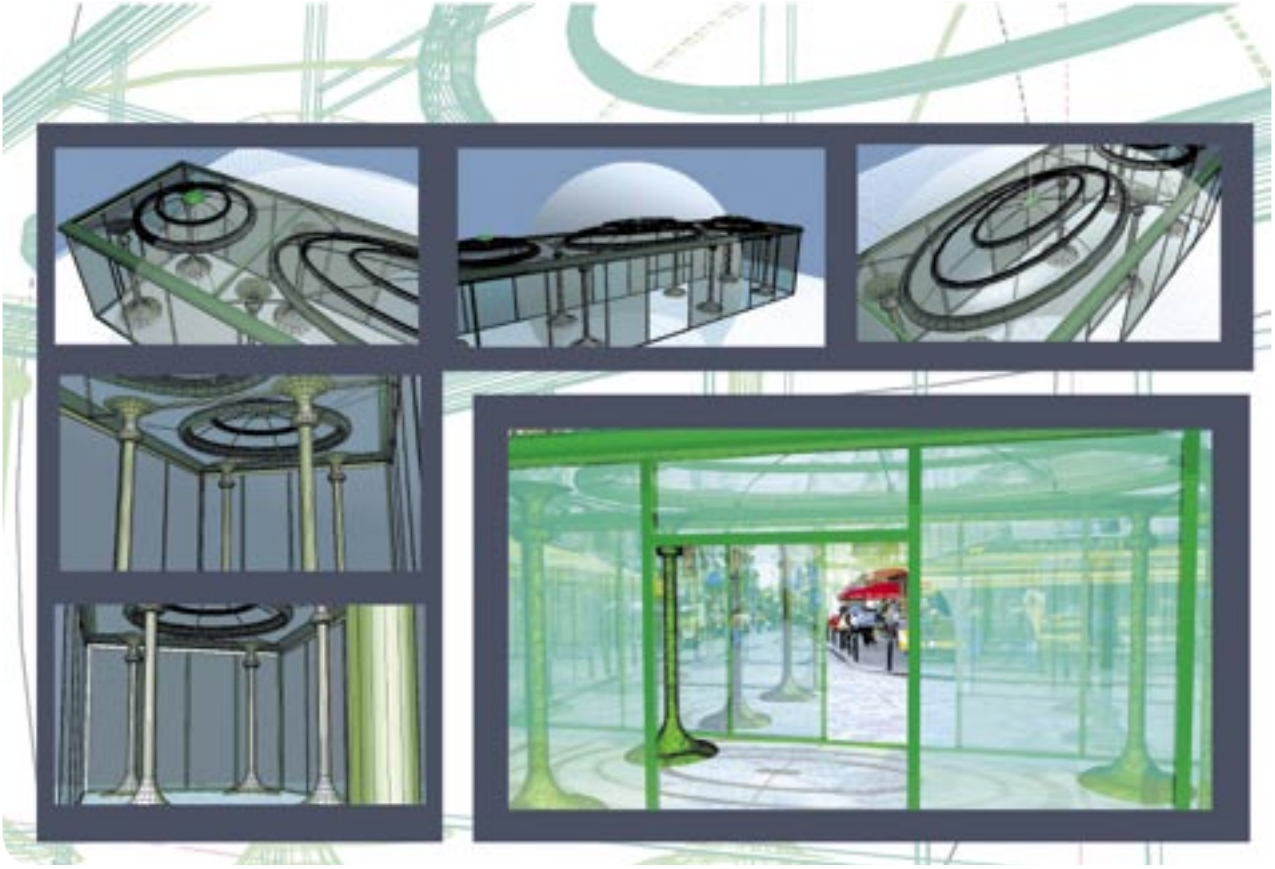
ANNIE CAMPOS
Production Design Concept for the film "Gattica"





MIA CHO
Production Design Concept for "The Wizard of Oz-3000"

MEGAN HUTCHINSON
Production Design Concept for "Labyrinth"



BRANDI HUGO
Production Design Concept for "The Tenant"