

Megastructuralism and Biomorphology: The Architecture of Manfredi Nicoletti

ANDREW VRANA
University of Houston

In the 1960's, a series of trends in architectural theory and practice converged in the work of several groups of young designers around the world. A crisis within the strict adherence to Modernism was becoming apparent. Its rational formalism was increasingly viewed as dogmatism linked to a monolithic political and technical power structure that they sought to subvert. It had lost its connection to the *avant garde* and had become a static, closed system of spatial and economic domination. Groups such as *Archigram* in England, the *Situationists* in Holland, the *Metabolists* in Japan, *Archizoom* and *Superstudio* in Italy appropriated the imagery and organizational structure of pop culture to align themselves with the larger movement of dissent that was emerging around the world. These groups, through various manifestations, were interested in exploiting the potentials of new media to transform architecture. They engaged infrastructure and landscape in a more active role by proposing megastructures that approached the immensity of mass media. Architecture and the city would inevitably take on new forms and a different political dynamic would be afforded through direct confrontation with large-scale interventions.

Manfredi Nicoletti is a lesser-known figure who was active in this period through a series of projects that incorporated biomorphology and ecological concerns to propose a radical architecture that should be noted for its innovation and technological vision. The size and scope of the projects approached the scale of infrastructure in many cases and inevitably would have reconfigured the cities they were a part of. The incorporation of landscape was a means to integrate architecture with a larger ambient ecology that he sought to infuse in the city. He used biomorphology such as evolving curvilinear geometries of growth and organizational systems of flux and movement to diagrammatically synthesize his architecture with Nature. He used the megastructure as

an extension of the earth's ecology to reorganize the flow of landscape, water, and air to affect the immediate microclimate around the project. New typologies such as "*skysHELLS*" and "*helicoidal skyscrapers*" were developed as prototypes of a new paradigm that sought to replace static, pre-determined forms of Modernism with dynamic integrated systems of structure and movement. His career is marked by encounters with some of the most important architects of the 20th century who he either worked or studied with.

MEGASTRUCTURALISM

Several architects of the 1960's were exploring the potential of the megastructure to subsume the city and its environment with a colossal project of reorganization. The Italian group *Superstudio* sought to deploy a ubiquitous system of connectivity based up a neutral field that would proliferate across the boundaries it sought to dissolve within society and between people. This utopian project often took on the role of abstract infrastructure in the landscape.

"We believe in a design that can be transferred, changing only scale, into different semantic areas, remaining true to itself, with no traumas or other snags. This immutability interests us: the search for an impassable, unalterable image, whose static perfection moves the world through the love that it creates." (*Superstudio*, p. 93, 1971)

A similar group *Archizoom* also from Italy proposed the "*Non-Stop City*" as a response to the limitless influence of electronic media and capital to influence the form of the city. The structure became so large that there was no longer an outside or a frame, just a relentless system

that was differentiated through the will of the user on the local level.

“The metropolis ceases to be a ‘place,’ to become a ‘condition’; in fact, it is just this condition which is made to circulate uniformly, through consumer products, in the social phenomenon. The future dimension of the metropolis coincides with that of the market itself.” (Archizoom, p. 144, 1971)

Manfredi Nicoletti was aware of this condition that architecture was changing scale in relation to the city but he sought an ethos that was not ironic or overly artificial. To him Nature was a complex symbiotic process that architecture could become a part of by incorporating its vitality, not as metaphor but as a means to inject its beneficial effects into the city. The type of megastructure Nicoletti pursued was more interested in using technology and scale to propose a new urban typology that created dense social conglomerations in innovative configurations. In the process, he sought to solve problems of infrastructural nature through the management of connectivity and exchange of different types of movement. He held the optimism that architecture could become an integral piece of the larger metropolitan structure by taking on a massive scale. Landscape became a constructed entity that could be inhabited. He used metaphors of Italian terraced hillsides as models for massive housing complexes. Landfill and artificial islands are used to extend waterfront zones to accommodate the transfer of transportation systems between the city and the sea. These were additions to the existing urban structure and not replacements that sought to obliterate the old city as Modernism had demonstrated. It aspired to create a new urban ecology by increasing the amount of open green space by consolidating the massing of the buildings and orientating them toward the sun with a network of terraces that perforated the surface. He was also sensitive to the effects of the airflow on the surfaces of the buildings in order to make the structure more efficient and to channel polluted air out of the city. He used the flows of traffic (vehicular, pedestrian, and maritime) to shape his urban form that organized movements into logical patterns that produced novelty without referring to historical or Modernist models. The use of infrastructure as a common ground for diverse functions produced intense programmatic mixtures with landscape features that merged to connect to the form of the buildings.

“The principal of a limit is always fundamental to the generating process of form. Kant clearly explains its value distinguishing it from a boundary. The latter is a ‘pure negation that qualifies a size.’

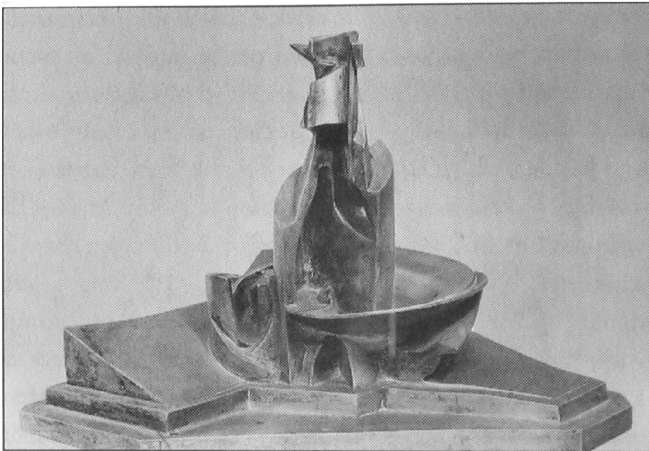
The limit instead ‘in extended beings, always presupposes a space that is beyond a certain determined area, also including it within itself.’” (Nicoletti, p. 20, 1978)

He used the term “*macromodule*” to refer to the principal of managing growth and change through system of limits that extended beyond the grid of the traditional city to engage the scale of a constructed landscape. He also felt these type of megastructures had an economic dimension that connected with the emerging markets of the ever expanding metropolis. The *macromodules* had sub-groupings that allowed for flexibility on the scale of the individual. Thought there is a relative homogeneity in the *macromodules* he developed, he projects that further diversification could be developed between the parts to design in more variation by influencing local change based on large scale relationships. As C. H. Waddington states in his studies of modularity in Nature, the modular laws of certain living tissues is based, not on the reproduction of equal cells, but on the principals of aggregation which he calls “relationship of neighbors.” (Waddington, p. 20, 1966)

While no direct contact is documented, the connection to the ideas of the Italian Futurists and the work of Nicoletti, especially Umberto Boccioni and Sant’Elia, is apparent. The iconic sculpture *Sviluppo di una bottiglia nello spazio* became the realization of the futurist notion of form determined by vectorial lines of force orbiting in centrifugal configurations within a field of differentiated intensities. The temporal accumulation of energy produced evolutionary effects of constantly changing states of being (Kwinter, p.93). The futurists sought to harness these flows into their work. Sant’Elia sought to manifest this into urbanistic proposals that went beyond the scope of mere buildings. *La Citta Nuova* is a series of megastructures that channel various forces in the city brought on by the changing technological landscape that was emerging in the early 20th century. The Milan station in particular is an intermodal connector of different systems of transportation including an airport, a train station, automobile roadways, tramways, funiculars, and pedestrian malls—all held together by an infrastructure of information and economy. His schemes for high-rise structures exploit the vertical surface as an opportunity to channel the flows of movement into elevator and mechanical shafts that connect to residential floors which setback gradually as they move up the building, allowing light and air to penetrate the floor slabs. He sought to reorganize the city as a continuous inhabited field that accommodated all modes of communication and exchange. By exploiting the vertical dimension as never before, the section

of the city would have a new depth and living spaces would be elevated into a new relation to the urban environment and infrastructure.

“The house... must rise from the brink of a tumultuous abyss; the street itself will no longer lie like a doormat at the level of the thresholds, but will plunge storeys deep into the earth, gathering up the traffic of the metropolis connected for necessary transfers to metal catwalks and high-speed conveyor belts. We must exploit our roofs and put our basements to work... dig out our streets and piazzas, raise the level of the city, reorder the earth’s crust and reduce it to a servant of our every need and fancy.” (Sant’Elia)

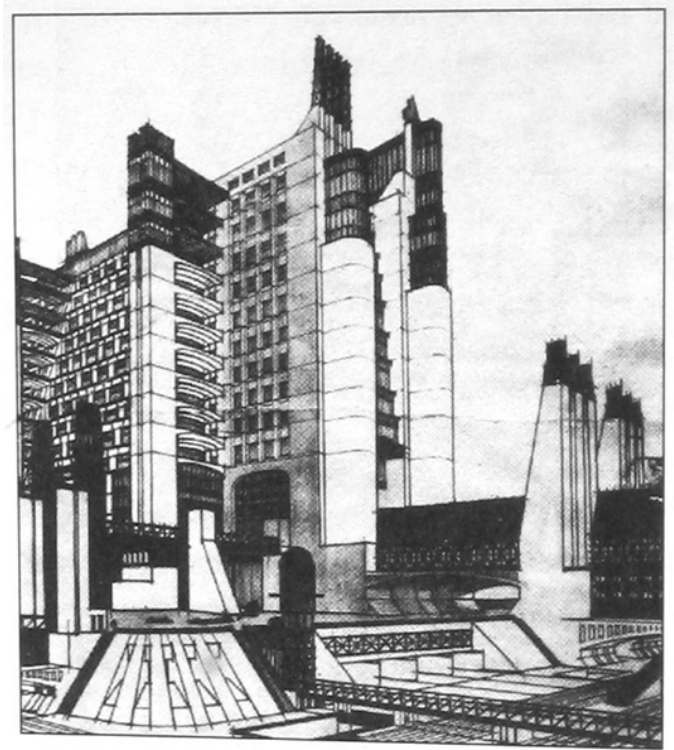


Umberto Boccioni Sviluppo di una bottiglia nello spazio 1912

Nicoletti used similar techniques to create colossal urban agglomerations that combined different scales of movement in a thickened ground from which emerged vertical structures that seemed to grow from the energy they harnessed from the urban systems and environment around them.

BIOMORPHOLOGY

Morphology, or the study of form, is a technique that works across multiple disciplines. Mineralogists study the structure of crystals, meteorologists study the patterns of weather systems, and biologists study the shape of organisms to classify qualitative difference in their field. They all work under the common premise that the form of the entity is the resultant of all the endogenous constraints and ambient forces exerted upon it (Thompson, p. 11). Internal information, be it chemical, structural, or genetic, gives the code or abstract set of rules that drives the local growth of the entity. Environmental forces such as location, climate or gravity force the



Sant’Elia La Citta Nuova 1914

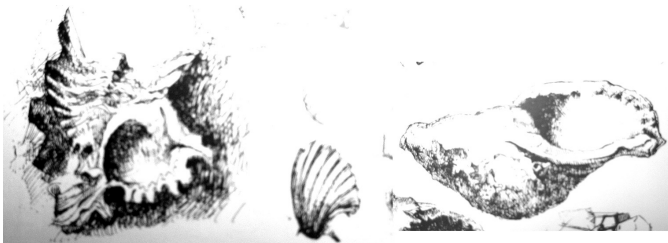
system to adapt to large-scale influences. As this information inevitably changes, the entity evolves to the next optimal state of being. Geometry is used in each case to represent growth and changes in form.

This was the interest of D’Arcy Wentworth Thompson, who analyzed the mathematic and physical aspects of biological processes. He documented the symmetry, proportion, and modularity of various living things as the irreducible relationships that determined all form. He applied techniques of topology with the Theory of Transformation to study variation within a group of organisms such as fish, shells, and skulls. By applying curves superimposed on a Cartesian reference system and changing the spacing of the grid, the form of the specimen changes producing difference that relates to the variation within the evolution of the species (Thompson, p.271).

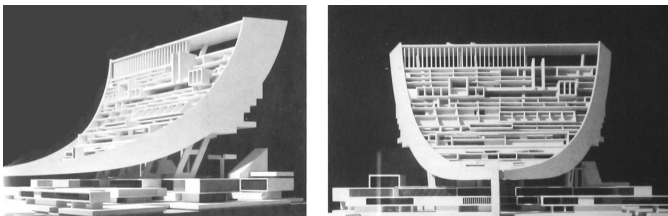
The mathematician Rene Thom used the term “morphogenesis” to describe the process by which form emerges over time under the influence of internal and external forces exerted on a system. A “catastrophe” occurs when there is a significant change of state within the system, such as the point where water freezes or the boiling point. All matter is channeled into a completely new structural pattern by changing its temperature with ambient energy. (Kwinter)

Nicoletti was aware of these studies and manifested them into his architecture. He was intensely interested in using natural processes to inform his urban systems. Geological metaphors were actuated to provide models for novel patterns of spatial and scalar relationships. He sketched landscapes relentlessly to imbue his gesture with the flow and energy of the earth's crust. He sought to reorganize the urban visual field in terms of dynamic fields of inhabited surfaces that continuously varied in the vertical dimension like sedimentary rock layers in a massive eroded topography.

He used the notion of internal constraints to develop proto-typologies such as the "skysHELLs" that were based upon a basic sectional diagram that gradually stepped back with each successive floor. The larger plates on the lower level were to be used for parking and commercial space where they didn't need as much light and could be connected to underground transportation infrastructure. The upper levels where optimal for living spaces were the setbacks afforded ample surface for landscaped terraces to create an urban ecology. This section was deployed into the urban plan according to ambient forces of connectivity and environmental influence. The section varies on the local level by the will of the inhabitants and on the global dimension with differentiation in its relationship to the adjacent module.



Manfredi Nicoletti Shell Studies



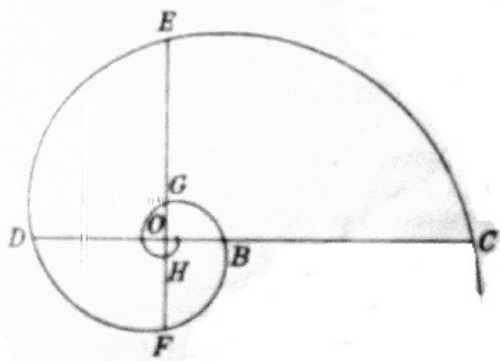
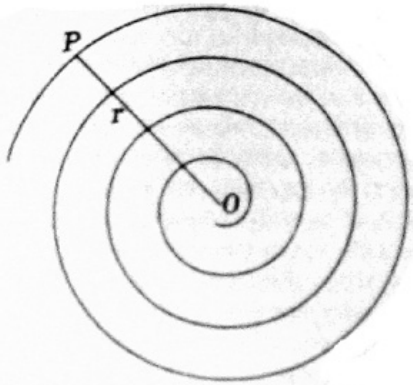
Manfredi Nicoletti Skyshell Module

The diagram of the *helicoidal skyscraper* exemplifies his research into continuous variation in a vertical structure that had the attributes of the *skysHELL* amplified to a large scale. He argued that the effects were not only on the programmatic and organizational level but also on the structural dimension. The helicoidal form, a series of

series of nested Fibonacci spirals, was efficient in that it accommodated for secondary lateral forces as well as minimized the effects of wind load with its variegated aerodynamic surface. Archimedes studied the efficiency and energetic potential of this shape in antiquity with his "water screws" as way to displace water vertically by channeling it into a revolving spiral aqueduct. The spiral has the ability to organize points in space that change periodically as they revolve around an axis, channeling the forces of acceleration and inertia with minimal dissipation of energy. Gilles Deleuze and Felix Guattari further discuss in their text *The Smooth and The Striated* the spiral or vortex as a pure geometric figure that represents a move toward differentiated, heterogeneous "smooth" space from static, hierarchical "striated" space.

"Let us try to understand in the simplest terms how space escapes the limits of its striation. At one pole, it escapes them by declination, in other words, by the smallest deviation, by the infinitely small deviation between a gravitational vertical and the arc of a circle to which the vertical is tangent. At the other pole, it escapes them by the spiral or vortex, in other words, a figure in which all the points of space are simultaneously occupied according to laws of frequency or of accumulation, distribution; these laws are distinct from the so-called laminar distribution corresponding to the striation of parallels. From the smallest deviation to the vertex there is a valid and necessary relation of consequence: what stretches between them is precisely a smooth space whose element is declination and which is peopled by a spiral. Smooth space is constituted by the minimum angle, which deviates from the vertical, and by the vortex, which overflows striation." (Deleuze and Guattari, p. 489)

The tower has a structural system revealing a dynamic choreography between compressive and tensile members. By incorporating masts for elevators and mechanical shafts we were able to consolidate the pure vertical forces to the core. The radiating floors slabs are supported by a meshwork of diagonal tensile cables that follow the curvature of the resulting surface and form the substrate for the curtain wall support. The interaction of these systems integrates hierarchical stacking with a network strategy that dissolves the tower into a smooth array of flowing surfaces that revolve around an axis.

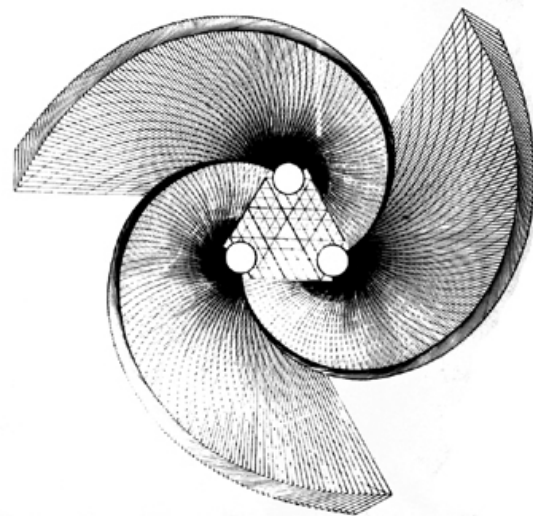
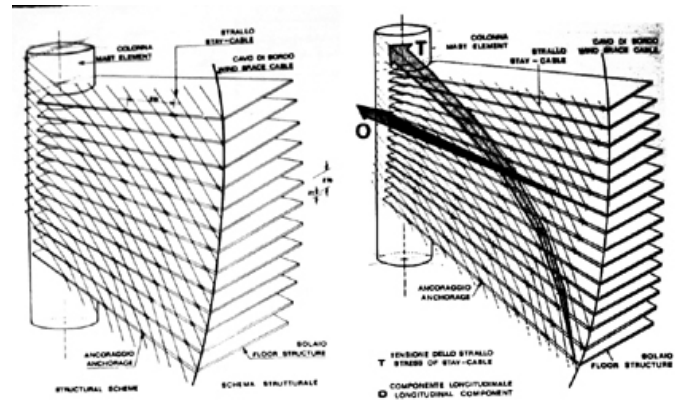


Spirals: Archimedes above, Fibonacci below

ENCOUNTERS

In his formative years Manfredo Nicoletti had contact with Walter Gropius, Louis Kahn, Eero Saarinen, Minoru Yamasaki, Buckminster Fuller, and Pier Luigi Nervi in his education at MIT or through employment before he established his own office.

The influence of Fuller is apparent in his belief that architecture could connect to a cosmic order through structure and geometry. While this has always been a desire within architecture, it was Fuller who sought to completely revise architecture based upon the scientific breakthroughs of the early 20th century that were beginning to reorder the aesthetic of design production on a deep structural level. His notion of the *dymaxion*: a pseudonym for dynamic, maximum, and tension. Which was manifested in a manufactured house that used a central mast and series of radial cables that supported a dome-like shell. The later studies in *tensegrity*, while more sculptural, are pure expressions of a balance between tensile and compressive forces by introducing triangulation into the system. He revealed the emerging notion that abstract relations in the universe were more complex than what classical binary dualities could



Manfredo Nicoletti *Helicoidal Skyscraper Structural Diagrams*

represent. Nicoletti clearly incorporated these diagrammatic schemas into his work and applied it to complex urban applications.

Nicoletti's connection with Pier Luigi Nervi is evident in their common use of force diagrams to determine form and the ambition to merge architecture with the scale and utilitarian sensibility of infrastructure. They understood structure as a resultant of internal and external forces in much the same way that Thompson found the human tibia to be an engineering marvel.

"The case of the tibia... on which the weight of the body rests. It is obvious that, under these circumstances, the engineer would find it necessary to devise means of supporting this flat roof, and for distributing the vertical pressures which impinge upon it to the cylindrical walls of the shaft." (Thompson, p. 230-231)

The plasticity of form in their work is attainable through the use of concrete which is a material deeply

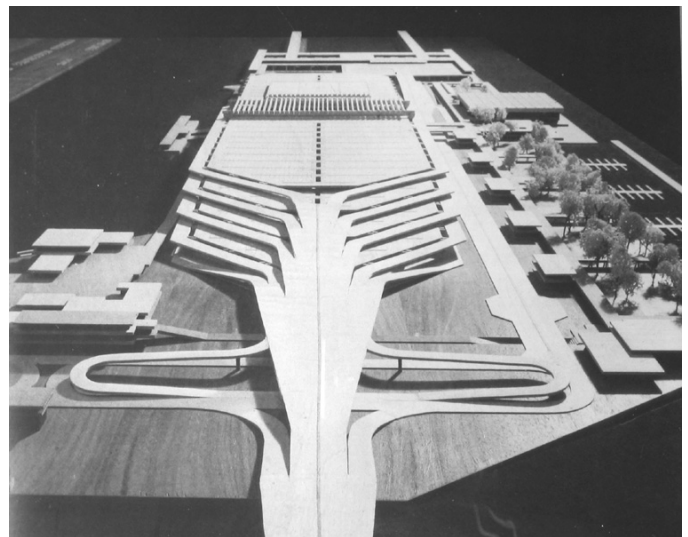
rooted in their culture's building technology since its development in the Roman era. Nervi's drawings of the articulation of the reinforcement bars to optimize the shape of structural members are analogous to Nicoletti's use of wind force diagrams to determine the aerodynamic shape of his buildings. Nervi designed stadia, stations, bridges, and later airship hangers in the war. The utilitarian nature of these typologies amplified their scale to the level of infrastructure. They are in effect realizations of the fantasies of Sant'Elia and prophetic to the interests of Nicoletti and his generation in the 1960's. Nicoletti sought to extend the notion that force-lines emanating from his architecture could connect to the city through a new dimension of landscape urbanism.

NEW ISLAND OF TRONCHETTO-VENICE, 1963-1964

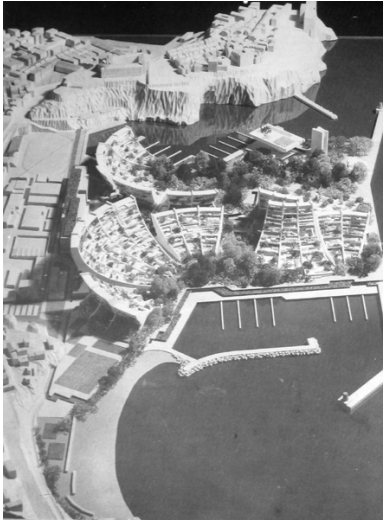
Medieval cities in Europe are faced with the problem of accommodating modern transportation systems. Venice is an aquatic city that is built on an archipelago. It developed as a fortress city so its fundamental structure makes it impenetrable to easy connection from the mainland or sea. A causeway has been built for road and railway connections. The competition required a solution to the problem of channeling the vast number of people accessing the city by various scales of transportation. Nicoletti proposed a megastructure in the form of an artificial island that would manage the flow of automobiles with a series of bifurcating ramps that feed a mat of parking garages for 6500 cars and 500 buses. A Maritime Station simultaneously clears passengers and freight from 6 ocean liners and deposits them onto boats, cars, or railroads. The Canal Harbor is for loading freight onto smaller boats that service the city. Open strips of flexible structures accommodate a yacht center, hotels, sporting facilities, auditoriums, and administrative facilities for the port authority. A large pedestrian concourse is the place where the exchange occurs between different modes of transportation and secondary activities internal to the building. In is a vast constructed landscape of convergence and dispersal that was to connect Venice to the global network of movement driven by tourism and international trade. This type of building and the solution Nicoletti proposed is strikingly similar the recent project for Yokohama's International Port Terminal by Foreign Office Architects (FOA) that has recently finished construction. Their desire was to make a public space that would be shared by the boat passengers and the city by merging the building with a landscape that seamlessly connects various types of spaces with a series of bifurcating slabs that fold to connect to other levels.

SATELLITE TOWN-MONACO 1966-1973

This was a proposal to increase the urban population of Monaco by 60% by constructing on an artificial peninsula into the Mediterranean. The cultural and touristic amenities would connect to the vast chain of development along the Cote d'Azur and beyond. Waterfront infrastructure typologies such as harbors, waterbreaks, jetties, seawalls, and piers were used to optimize the accessibility to the ocean and to bring water into the complex. Skyshell modules are deployed in loose radial configurations that recall the terraced hillsides indigenous to the coastal topography. They set up a flexible framework where substructures are variable and undetermined. The entire megastructure is a landwork of "geological architecture." The spacing of the superstructures and their flexibility allows for a network of movement that flows between and through the buildings and landscape to organize pedestrian and vehicular traffic with intersectional connections. The concentration of buildings affords the use of an interwoven green space that merges with the inclined landscapes of the skyshells. The upper levels of the shells are private residential and hotels while the lower levels are filled with commercial and cultural activities. Parking garages are suppressed underneath where they are connected to subterranean roadways. The main axis of access is framed by the massive convex profile of the shells, thus creating a Venturi effect that forces pollution out when sea breezes push through. The project epitomizes Nicoletti's desire to create an urbanism that forms a continuum with the environment by channeling Nature's organizing principals and merging them with technology.



M. Nicoletti Venice Aerial View Port Terminal

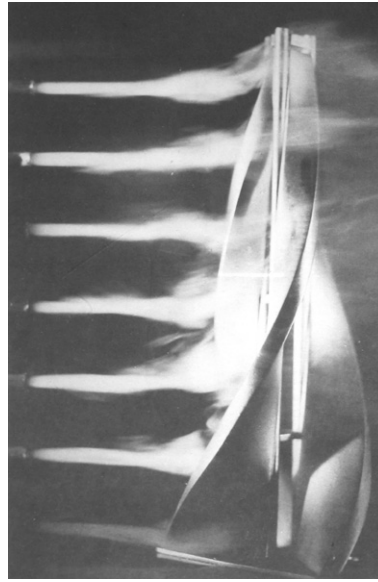


Manfredi Nicoletti Satellite Town-Monaco

NEW YORK CRESCENT PROJECT AND HELICOIDAL SKYSCRAPER, 1968-1973

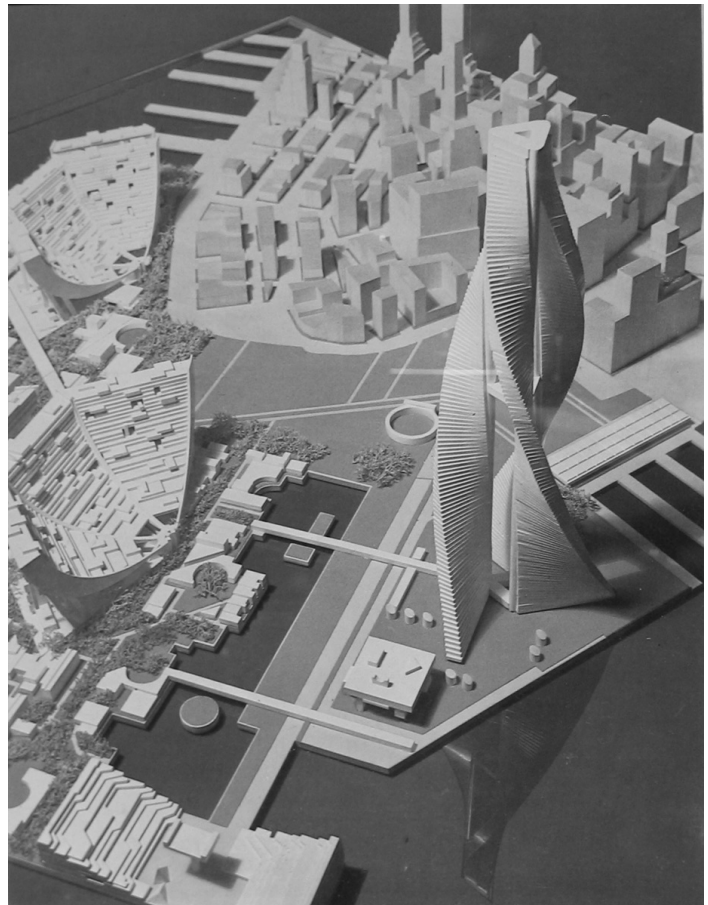
Nicoletti was invited to address the problem of enhancing the central business district of Lower Manhattan during the time that Battery Park City and the World Trade Center were in under construction. He became interested in the fact that over 300 years this part of Manhattan had double its original size through a recurring landfill process into the rivers and harbor. He sought to integrate housing and commercial space to reconcentrate inhabitation to alleviate problems of congestion caused by excessive commuting. Three proposals were developed a landbridge that would connect to Governor's Island, an artificial island, and an extension of the existing edge along the Battery. The *skyshell* was used in radial and axial configurations and adjustments were made to align it with the geometry of the city. Its potential to create a heterogeneous mixture of residential, commercial, cultural, and parking spaces within a unified module was especially appropriate for the project. The site planning incorporated existing infrastructure like the Brooklyn Battery Tunnel and proposed new harbors within the expanded waterfront.

Central to the project is the 565 meter Helicoidal Skyscraper. It's clearly a reaction to Minoru Yamasaki's World Trade Center that was already under construction and with whom he had studied with at MIT. It was emblematic of his desire to make architecture that emerged from the landscape with a biomorphic geometry that channeled the forces of the site with aerodynamic properties. The strong winds present in New York Harbor would be dissipated by the curvature of the surface. He was interested in the economic advantages of minimizing the weight of the building and allowing



Wind Tunnel Test

for flexibility on the floors by eliminating the normative column grid. The design was subjected to a series of analytical tests that measured the qualitative and



Manfredi Nicoletti New York Crescent Project and Helicoidal Skyscraper

quantitative effects of the particular geometry. The model was placed in wind tunnels to observe the resulting airflows. Thermographic maps were used to measure the stresses within the structure based upon differing internal and external loading conditions. In effect, the Helicoidal Skyscraper marked a paradigmatic shift in the way towers could be developed and built. Manfredi Nicoletti was truly anticipating a different kind of architecture that merged nature and culture with megastructural technology and complex biomorphic geometry.

BIBLIOGRAPHY

- Burns, Jim. *Arthropods: New Design Futures*. New York: Praeger Publishers, 1972.
- Da Costa Meyer, Esther. *The Work of Antonio Sant'Elia, Retreat into the Future*. Yale Press, 1995.
- Dahinden, Justus. *Urban Structures for the Future*. New York: Praeger Publishers, 1972.
- Deleuze, Gilles and Guattari, Felix. *A Thousand Plateaus*, Minnesota Press, 1987.
- Foreign Office Architects, website: www.f-o-a.net. Yokohama International Port Terminal. 2003.
- Kwinter, Sanford. *Architectures of Time: Toward a Theory of the Event in Modernist Culture*. MIT Press, 2001.
- Kwinter, Sanford. "Landscapes of Change: Boccioni's "Stati d'animo" as a general theory of models". *Assemblage 27*, 1992 December. MIT Press.
- Nervi, Pier Luigi. *The Works of Pier Luigi Nervi*. New York: Frederick A. Praeger, 1957.
- Nicoletti, Manfredi. *Continuity Evolution Architecture*, Bari, 1978.
- Thompson, D'Arcy Wentworth. *On Growth and Form*, Cambridge, 1961.
- Waddington, Conrad H. "The Modular Principle and Biological Form" in Gyorgy Kepes, ed., *Module, Proportion, Symmetry, Rhythm*. New York: George Braziller, 1966.