

URBAN LANDSCAPES

Intermodalities of Miami: Public Transportation Projects

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INTERMODALITIES: Water, Land, Air...

The geography of the South Florida metropolis is that of a long and narrow urbanized strip, 90 by 15 miles, stretching north to south from Palm Beach to Homestead. The natural physiognomy of the region is framed on the eastern front by a string of sand barrier islands on the Atlantic Ocean and the edge of the Everglades aquifer on the west — the Intracoastal Waterway, a navigable artificial canal connects a series of natural bays and lagoons that separate the barrier islands from the mainland. The Florida Keys, a row of limestone and coral reefs, thrust 125 miles further southwest into the Gulf of Mexico, reaching its southernmost point at the historical town of Key West — a refuge for a succession of buccaneers, political expatriates and American poets.

*If it was only the dark voice of the sea
That rose, or even colored by many waves;
If it was only the outer voice of sky
And cloud, of the sunken coral water-walled,
However clear, it would have been deep air,
The heaving speech of air and summer sound
Repeated in a summer without end
And sound alone.*¹

By water: The Everglades, the Miami River, the Port of Miami...

The geology, archeology and mythology of the region prompt a question: where do you begin? Miami is an Indian word meaning *sweet water*... In the Miami River, a natural drain of the South Florida aquifer, the brownish water from the glades, infused with metabolic detritus, mix and dissolve intermittently with clear spring waters. Tidal action extended



1. Towing cargo ships on the Miami River, with Metromover span on the background.

close to the headwaters, but the heavier brackish water was prevented from receding further by the rapids, or falls at the edge of the Everglades.

*The miracle of the light pours over the green and brown expanse of sawgrass and of water, shining and slow moving below, the grass and water that is the meaning and central fact of the Everglades of Florida. It is a river of grass.*²

Today, after dredging the riverbed and building of artificial canals to improve navigation and marine industry, the river still retains traces of its vector of natural flow cutting a diagonal swat across the orthogonal pattern of the city. Much of the eastern edge of the Everglades has disappeared after repeated channeling and draining to provide land for agriculture and westward expansion of the city. Salinity dams have replaced the natural function of the rapids. What remain now are incidental lagoons and ponds scattered among urban and industrial development.

The Miami River is a shallow draft seaport, doing business primarily with the Caribbean Basin. Contrasting with the luxury cruise liners that dock in

Biscayne Bay at the Port of Miami, those who venture up river are battered freighters doing industrial hauling, fishing boats that unload their catch at the many fisheries located on the river's edges, and a plethora of small makeshift vessels flying Caribbean flags. The latter have become permanent fixtures lining the riverbanks, barely a few blocks from downtown Miami. Overloaded with second hand appliances and surplus merchandise, they seem to be forever on the brink of departure — a nomadic urban colony, collecting the refuse of a wealthy society and suspended in time at the water's edge.

On land: drawbridges, highways, elevated trains...

An intense relationship between the city and the water occurs at the river crossings. Ten operating bascular drawbridges, each under the watch of a bridge tender, span the river stitching back the orthogonal fabric of the city. The exposed mechanism of the drawbridges reveals an almost archaic technology of gigantic gears, cantilevered girders and counterweights, resembling skeletons of prehistoric amphibians washed up at the riverbanks. But the fleeting resem-

blance is quickly dispelled when the enormous clockwork mechanism is set in its up-and-down motion.

Bridges are practical structures and powerful aesthetic objects. For impatient motorists, they are the only evidence that the river exists. For boaters, they are rhythmic visual gates that keep the beat of their river journey. And for pedestrians, they are points of passage where two elemental landscapes meet: water and land. A new practice of urbanity and civic architecture can be hammered out at the exact location of the bridges: a magnificent linear gallery and a theater of machines, a dispersed collection of large mechanical artifacts that animates the life of the city with the naïve mythology of efficient and playful monuments that sway between physics and fairy tale.

The overlap of the city map, based on an orthographic logic, and the meandering course of the river, responding to the dynamics of water flow, is a condensed version of the exchange between the *striated* and the *smooth* physiognomies of the landscape.³ In this exchange, the drawbridges gravitate towards the striated by their stability and alignment with the city, but respond to the *smooth* by their mechanical movement and transformation yielding to the flow of the river. The bridges counterpoint is manifest in the *unsettled settlements* of the "Tent City" of Cuban refugees beneath I-95, in 1980, and today's "Haitian Boats", both apparently fixed in the pattern of the city, but inevitably shifting to nomadic fabric patchwork and scrap metal shantytowns (Figure 2).

Contrasting with the aquatic and the earthbound movements is the third dimension of the quasi-aerial choreography of regional highways (I-95 and SR-836) and elevated trains (Metrorail and Metromover) that responding to different speed and spatial geometry inflect their smooth and mathematically elegant parabolic vectors, at least 75 feet high, over the terse compressed surface of the water.



2. Cuban "Tent City" beneath I-95, refugees from the exodus of 1980. Historical Museum of South Florida, 1980.

The overlapping vision of the river and the city from the lofty overlook of the highways and elevated trains brings to mind a compression of history. The simultaneity of the past geological time immersed in the fluent memory of the river, a territory now haunted by forgotten Indian burial grounds; the present time of the city of Miami, barely reaching its first centennial in 1996; and, the cybernetic promise of a future time afloat in the air, sporadically materializing in technologies of movement and information — *tempus fugit*.

The effects of enormous transportation structures such as I-95 and Metrorail, which traverse downtown Miami at elevations between 55 and 75 feet, can be the exhilarating vision of a *brave new world* from above, but devastating at ground level. The radical task of integrating these large linear public work structures, normally associated with engineering and vectors of movement, rational efficiency and economy, into the heterogeneous fabric of the city demands new philosophies and practices of land use, adaptation of road alignments to local circumstances, and continuous structural and aesthetic innovation.

Of air: tropical storms, the Airport...

The cosmopolitan glamour and ethnic frenzy lush tropical vegetation and

changing skies of Miami are haunted by the memory of devastating tropical storms. For centuries storms have wreaked havoc in the Caribbean region, punishing with natural neutrality the efforts and hegemony of power of the day: sinking Spanish gold galleons, blowing away the plantations of colonists and native settlements, and putting to severe test the ingenuity of modern structures.

Forty-seven thousand Miamians were left homeless by a hurricane, in 1926 that destroyed five thousand dwellings and killed 113 people. In 1992, Hurricane Andrew denied the naïveté that such natural disasters could not strike again. Eighty thousand homes were destroyed and 160,000 people left homeless. The normally ordered regimes of water and land were turned up side down: of the hundreds of boats in the harbor many ended on the streets, and the causeways were under water.

Natural forces and phenomena are inevitable ingredients of the region. An urban mythology of Miami may not be found in imported styles or depleted historical models — which raise the question of the image's truth — but must reflect its region in the dynamic interplay between natural forces, technology and a sensible aesthetic of construction.

For millions of visitors and immigrants, the first impression of the United States is a vision from the air of the barrier islands, the Florida Keys and the immense expanse of the *river of grass* of the Everglades. Located between the forks of the Miami River, the Miami International Airport is a major destination for domestic travel in the United States and connecting gateway for international travel from Europe, the Caribbean and South America (Figure 3).

One of the country's busiest airports, MIA handles 30 million passengers per year. Its projected growth forecasts 55 million passengers by 2010 and 70 million by 2020. It is unlikely that expansion of the airport functions could occur within the airport grounds.

To solve this problem and to ease east-west traffic congestion, the Florida Department of Transportation began, in 1993, studies for two major projects: 1) the Miami Intermodal Center, and 2) the East-West Multimodal Corridor (along S.R. 836) providing increased vehicular and train access between the Airport, downtown Miami and the Seaport.

INTERMODAL PROJECTS

Systematic requirements of these projects called for a proper understanding and adherence to existing or developing transportation technologies: either elevated tri-rail, high speed rail, surface light-rail, or automated people movers were primary functional parameters. Travel speeds, vertical and horizontal radiuses, and dimensional tolerances were determining factors in the spatial and structural organization of the buildings.

Other functional parameters required the integration of several modes of transportation on a case by case basis for each individual station: private and public land transit, water taxi and boat, helicopter and seaplane. The resultant programmatic hybrid in each case influenced the spatial arrangements.

Physiognomic requirements were derived from practical and aesthetic sensibility to each particular site. Boundaries are in most cases permeable technical and sensual envelopes and filters that establish a coherent dialogue between the regimes of air,



3. Miami International Airport and SR 836 (right) going to the Seaport. FDOT, 1993.

water and land, whether at the edge of the Everglades or Biscayne Bay. Boundaries were addressed at a series of levels, resulting in *similar differences* and *different similarities*.⁴ The perception of elevated trains over the river and adjacent to the lagoons, the high platforms at the edge of the harbor and within view of the cruise ships, the transparency of the slightly raised light-rail as it enters the beach, all these conditions refer back to the vectors and inflections of the respective modes of transporta-

tion: land to sea, air to sea, and land to air connections.

I. Miami Intermodal Center (MIC)...

The Miami Intermodal Center is to be considered as an *asymmetrical twin*, handling the landside expansion of the airport, and a *grand central station* collecting regional and local train circulation, including high-speed rail. The selected site is a triangle bounded by water on two sides and an elevated roadway to be designed

and built concurrently on the third side.

To the east and north the Miami Canal and to the south the Tamiami Canal are water boundaries. Palmer Lake, an inlet of the Miami Canal, is an area designated for preservation as a green space and ecological haven for breeding of manatees and other native species. Water has its own definitive and dynamic character. The canals were created for the movement of water and to reclaim land for urban development and agriculture. They were designed to accommodate requirements of volume, depth, and navigation. The day to day movement and interaction of water with its edge constantly changes and redefines the edges and cross-sections of waterways.

To the west will be the proposed elevated Interconnector joining S.R. 836 and S.R. 112. The elevated roadways have a curved geometry, which contrasts with the orthogonal grid of the city. This diversion from the grid, because of the specific curvatures related to mathematical calculations of speed and structural continuity give the roadways a unique language and aesthetic based on the dynamic and technology of movement.

The Airport is designed to accommodate the following functions: airplanes (landing, taxing and takeoff), passengers (arrivals, departure and waiting), baggage and cargo handling, and general ancillary functions of passenger service and transportation equipment and storage. This requires specific distances, clearances, and radii for the proper and safe operation of airplanes. The restrictions that apply for the Airport reach out and affect the built environment that surrounds it. The flight path has a set three-dimensional envelope that must remain free of physical interference. The same restrictions will influence the site planning of the MIC and joint development in the triangle.

A series of *kinetic impact probes* initiated the design experiment: deforming metal meshes of different densities with a kinetic impact. The impact was achieved with the use of a sixty-pound draw bow and arrows with differently sized blunt tips. The meshes were dipped in wax to enhance the reading of the deformations and intuit conceptual possibilities

of the same. The experiments yielded the following concept: using two layers as the elemental generator of the spatial envelope. Analogically, the different rail technologies would impact functionally and penetrate the station as a kinetic force. At the point of impact the station and rail would react with each other creating the resultant opening of the boundary along the vector of movement. The point of impact is the place where the rupture generates space and separation of the spatial envelope into two layers providing an interstitial space that can be used programmatically (Figures 4-5).

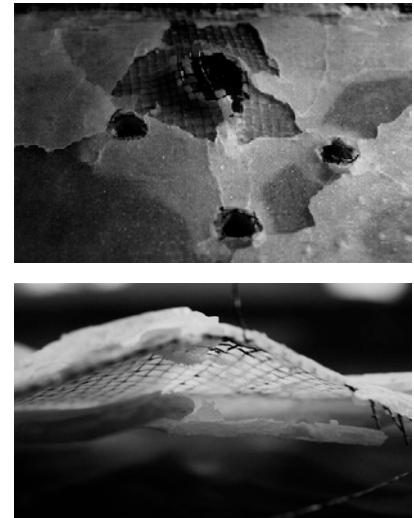
A computer generated *wire model*, was used to explore the fluidity and topological continuity of the envelope. The model explored the difference between the two layers. The outer layer displayed a tense and continuous surface in contrast to the interior layer, which showed greater dynamic deformation. The combination of the two layers reiterated the possibility of using interstitial voids, generated by the spatial and structural envelope deformation, for the primary functions of the program (Figures 7-8).

A *geometrical model* of construction and a rupture of the ellipse was an attempt to redefine mathematically the plan outline. The geometry of the plan is generated by vectors of movements and is a dynamic reconstruction of the geometry of the roadways. Geometry was also used as a method to simplify the regulating profile of the structural skeleton, in section, by means of a series of parabolic compression elements hinged at the ground (Figure 9).

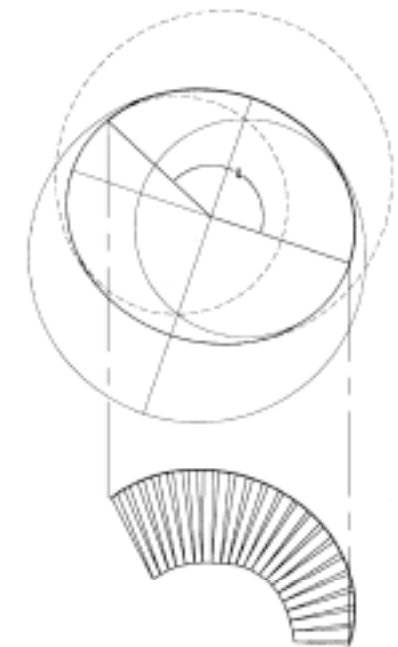
The schematic program includes: rails and platforms, vertical circulation, parking, water-taxi docking and lagoon — water is given a larger presence to organize and clarify the site perceptually and for its potential environmental benefit. The sectional layering is paradoxical, in the sense that there is an inversion of the typical arrangement for train stations. Traditionally train stations either sit on the ground or are below ground, in this case the rail tracks and platforms are up in the air, because all guideways must be higher than 65 feet when crossing the Miami River. Out of necessity, this is an aerial station and its roofs are aesthetically and structurally

dominant elements.

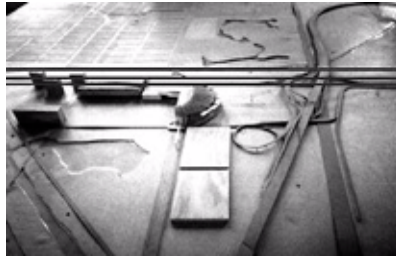
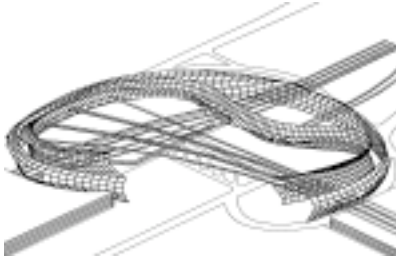
The station hall roof is parabolic in section and elliptical in plan; the roof over the platforms is shaped as a series of *airfoils*. A suspended tensile glass plane — a true *curtain wall* — between the two roofs separates the conditioned space of the hall from the open-air area of the platforms. Response to wind forces, airflow, sun shading, lightness and transparency were critical aspects of the design (Figure 10).



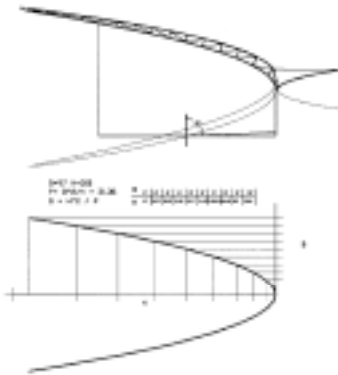
4-5. Kinetic impact modeling.



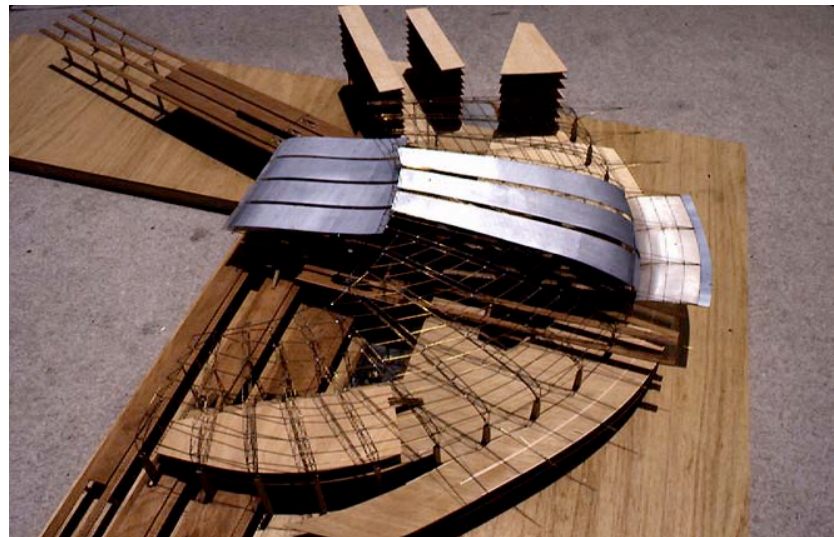
6. Geometric modeling, segmental ellipse generation by displacement of centers projected to plan outline.



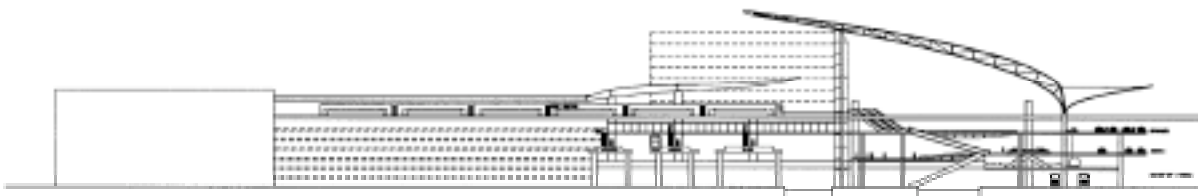
7-8. Computer wire modeling.



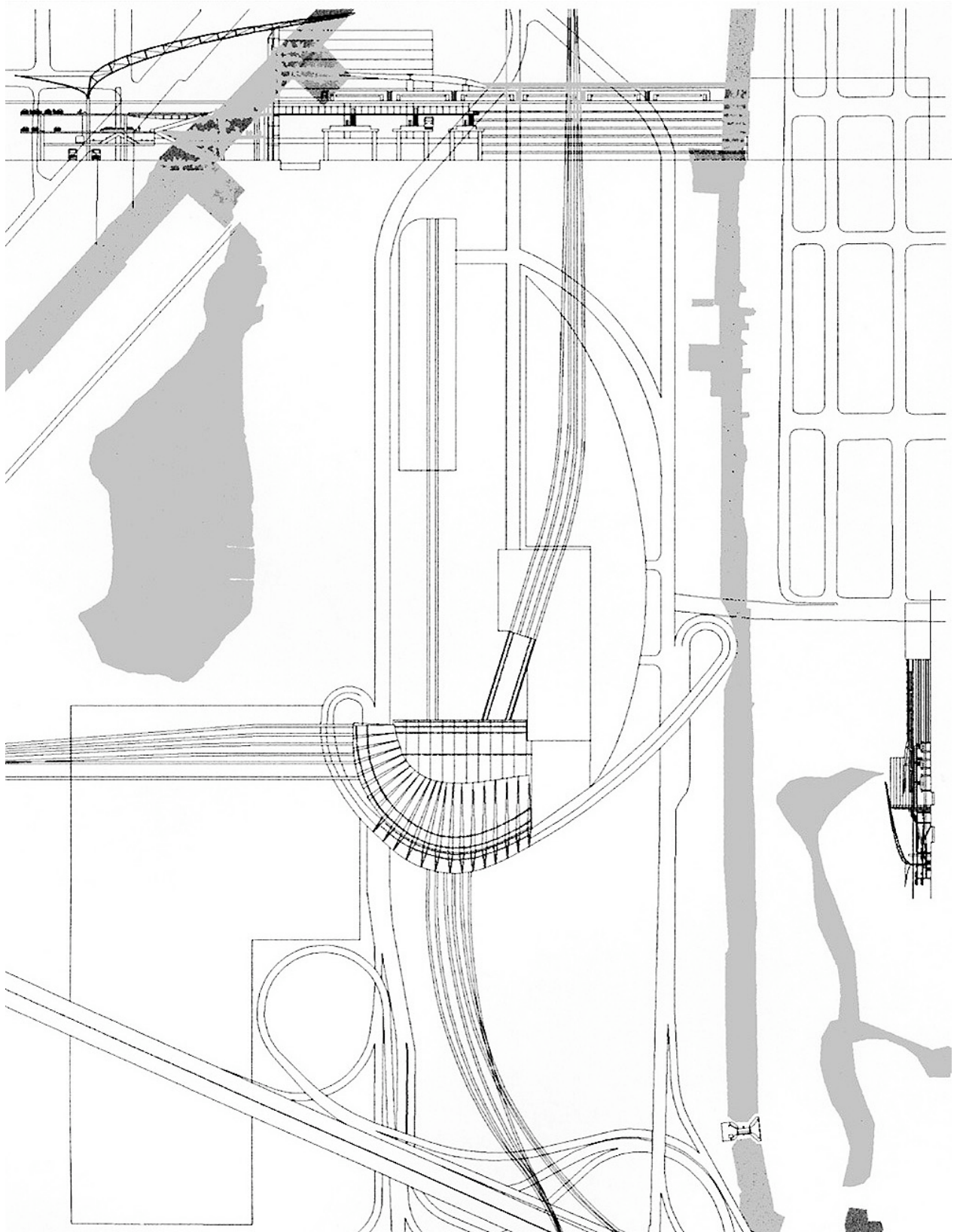
9. Geometric modeling, parabolic construction projected to sectional profile.



10-12. Miami Intermodal Center (MIC) models above.



13. Miami Intermodal Center transverse section.



14. Miami Intermodal Center (MIC) site plan.

2. Airport-Seaport Corridor: Bayside Station...

Bayside Station will be strategically located as a transportation hub connecting the Seaport, Airport, downtown Miami, and eventually Miami Beach. The station goals are:

- To provide efficient mobility between Seaport and Airport.
- To provide Metro Miami travelers with easy access to the airport and downtown activity centers.
- To contribute to increased mobility in the South Florida Region, supporting 21st century plans for regional transportation and sustainable growth.

The building is spatially interwoven with the elevated East-West train guideway. The design explores possibilities of creating dynamic facilities structurally and functionally integrated to transportation, using the land beneath mass transit system as efficient programmatic space linking and promoting transportation systems of the future as civic structures.

Conceptually, the plan yields to the movement of the trains above and vehicular traffic below. The water edge amplifies the possibilities of movement on water or hybrid systems: water-to-land and water-to-air.

The roof canopy has been shaped as a permeable airfoil that plays with air movement, promotes thermal comfort, and eventually reacts positively to strong hurricane wind forces

In this project, the 640-foot long rail platform at 61 feet above sea level determines the footprint of the building. The platform and concourse below form a spine linking the building's programmatic functions:

Level 1: The station hall on the ground floor is a three-story atrium, encircled by passenger services linking the different transportation modes. A glass curtain-wall facing the water frames views of the cruise ships docked close by, the cargo port and derricks further away on Dodge Island, and Miami Beach across the surface of Biscayne Bay

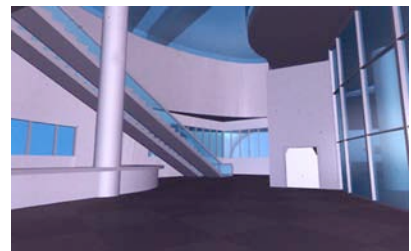
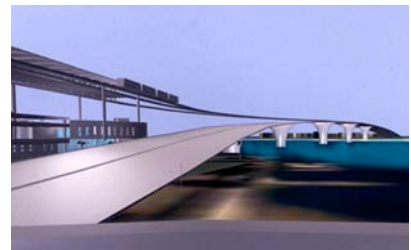
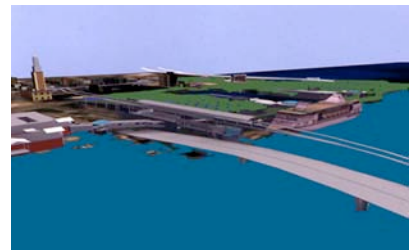
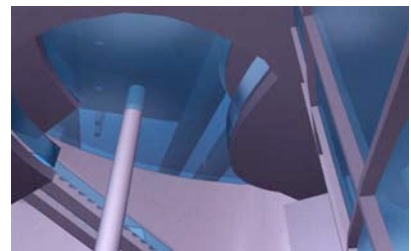
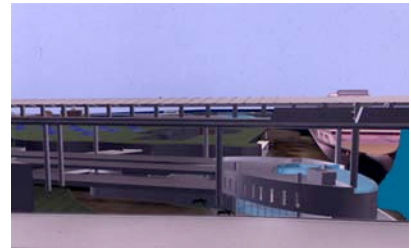
Level 2: Maritime offices and the train control and communications room. Two pedestrian bridges, one

connecting to Bayside Marketplace, and the other connecting to the proposed Maritime Park and a parking garage

Level 3: Miami Beach light-rail transfer platform, travel offices, an observation deck and maritime gallery with mural photo documentation of the historic evolution of the Port of Miami.

Level 4: Main platform area, open to the air but covered and shielded from the sun and the rain, providing 360 degree panoramic views of the seaport and the downtown skyline.

A computer generated spatial simulation (3D Studio) was used to explore visual qualities of the station. Exterior views examine the alignments of the infrastructural systems and the urban macro-textural qualities of the site. Internal spaces are intended to amplify the dynamic of external movement by inflection of similar spatial geometries and tuning vectors of circulation that refer visual orientation back to the open air and water. The three dimensional simulation exploring the application of materials, light, and textures to a wire frame model is a useful step at the beginning of the spatial modeling of the building. Although this is a rudimentary study that lacks the sophistication of measured lighting models, it offers a useful method to incorporate and study visual qualities that directly affect the spatial experience (Figures 15-20).



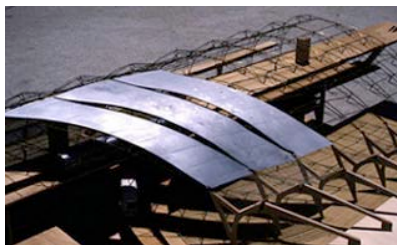
15-20. 3D Studio computer modeling of exterior-interior spatial sequences.



21. Bayside Station and Port of Miami expansion at Bicentennial Park, at the edge of Biscayne Bay, site plan.



22. Port of Miami Bridge. MB3D, 1995.



23. Bayside Station model.



24. Downtown Miami. Gleason, 1995.



25. Bayside Station model.

3. Miami Beach Gateway Station...

The station site was selected based on the following criteria:

- The existing geometry of transportation infrastructure: causeways, bridges, arterial and local collector roads — specially, MacArthur Causeway and its merging into the 5th Street and Alton Road intersection.
- The natural geography of the site, at a critical confluence of land and water, that will permit a true 'intermodal' connection of light train, public and private ground vehicles (buses, cars, electric shuttle, and bicycles), and water transportation (water taxis and small craft).
- The site's urban geography, at the edge of the internationally known Art Deco District, a prime tourism destination, and South Pointe, a fast growing medium to high density residential district with public access to an extraordinary waterfront.

To resolve public transportation and environmental problems, many large cities in North America and Europe have returned to light rail systems in the past 20 years. Light rail offers an environmentally clean, economically efficient, and aesthetically pleasant mode of public transportation. Siemens Duewag, with headquarters and manufacturing facilities in Sacramento, California, has supplied light rail vehicles and installations in seven major cities in the U.S. and two in Canada. In this study, particular attention has been paid to those systems currently operating in Portland and Sacramento. These cities have comparable ridership projections and a manifest concern for the impact of track alignments and stations on urban aesthetic.

The urban design program includes the following components: a small intermodal center, providing connection with other modes of land and water transportation; a visitor information center and gallery (being an entry point to Miami Beach and serving a large number of tourists, the station is the desirable location for introduction to the culture of the city); a waterfront promenade lined by ancillary

services and entertainment; a 180 room hotel, with adjacent meeting and exhibition rooms; and a low profile 500 car parking garage.

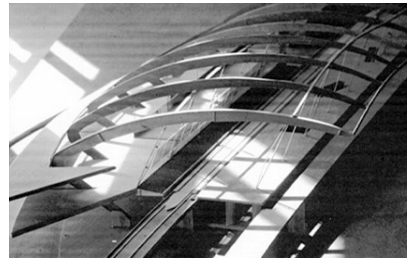
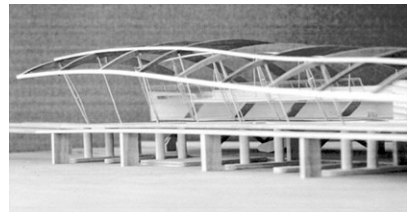
The public value of this waterfront site derives from its open edge exposed to extraordinary views and the cooling effect sea breezes — which sporadically may turn to tropical storms. The platform and canopy are sited hovering over the water and connected to the landside by a spatial wedge at grade level, with escalators going up to the light rail the platform and down to the water taxi dock. The visitor center and gallery, located at a mid-level mezzanine can be accessed from the station or directly from the exterior by a bridge ramp.

Access from the waterfront promenade and parking garage to the station is provided by a transparent weather canopy beneath the light rail track, which in the northern half of the site remains elevated, at 16 feet, to allow vehicular access and service to the waterfront, sloping down gradually to reach grade at the southern limit of the site. This linear canopy also serves as waiting area for transfer to the electric shuttle and city buses.

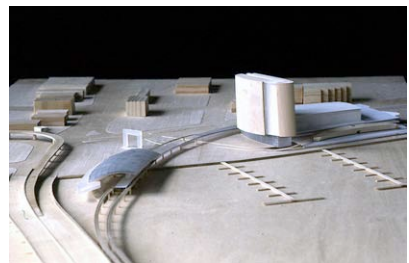
The spatial structure is defined by a metallic airfoil sheathed over a series parabolic rib-trusses hinged at the foundation and fixed on their cantilevered side by compression-tension struts. The struts would act on either mode in response to the changing wind directions and the dynamic effect of wind loads.



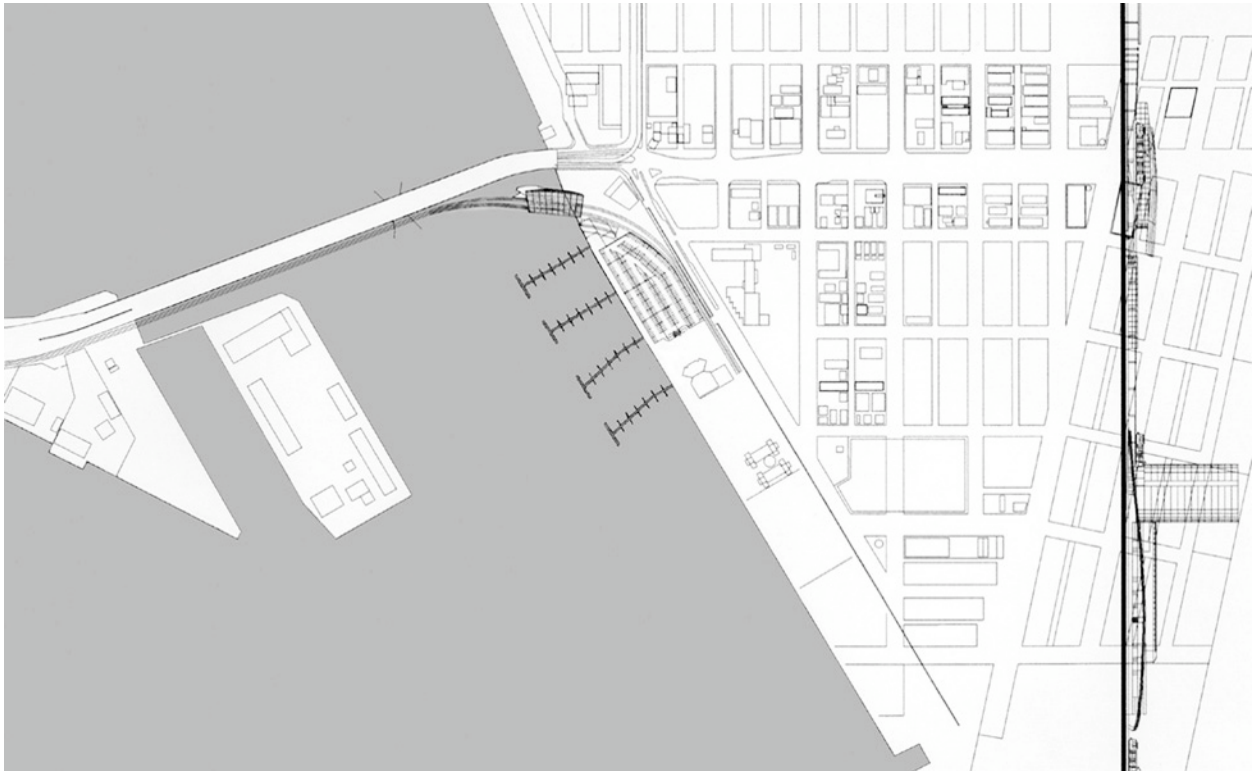
26-27. Miami Beach Station site.



28-29. Canopy study models.



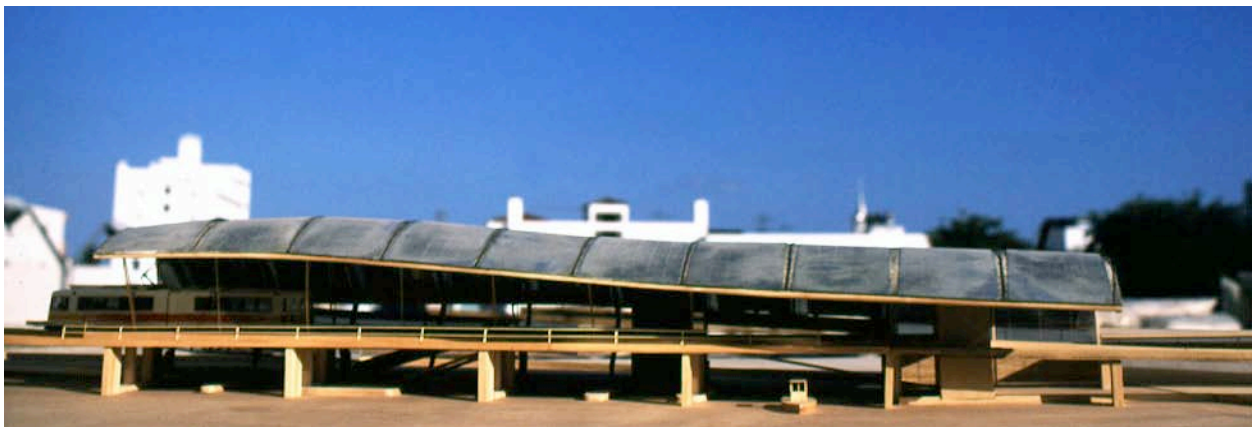
30-31. Site models.



32. Miami Beach Gateway Station and City Marina, at the eastern edge of Biscayne Bay, site plan.



33-34. Elevation and section.



35. Miami Beach Gateway Station, model.

4. SW 2nd Avenue Bascular Bridge...

This is a proposal for the replacement of the existing bascule bridge at the intersection of S.W. 2nd Avenue and the Miami River. It is aimed at creating a structure that has an integral functional relationship with the *working river* in which the river and the bridge have a physical interaction that is advantageous to both. The architectonic aspect of the structure is expanded by the proposal of a *civic program* of uses within, and adjacent to realm of the bridge's operational system.

The proposed bascule bridge is a simple 'trunnion', or hinge, also known as the 'Chicago' type, where the moveable portion made of the leaf and the counterweight, is carried by the trunnion when the bridge is in motion or open. The bascule is in dynamic equilibrium through its whole range of motion; the gravitational forces on both sides of the trunnion are always equal. The force required to move the leaf is minimal, needing only to overcome the inertia and the mechanical friction of the system.

A variation, proposed for this bridge, is based on 'Archimedes principle of displacement of water' — a submerged body becomes lighter by an amount equal to the weight of the volume of water it displaces. This is accomplished by increasing the counterweight, thus taking the leaf out of equilibrium and restoring equilibrium by placing the weight into water. Using this principle, the movement of the leaf will be aided by controlling the movement of water within the pier.

At the present, there is a significant amount of hydraulic turbulence at the site, caused by the geometry of the river bend and magnified by the existing bridge piers which project several feet from the edge into the water — turbulence hampers the navigation of vessels. The new bridge should lessen the turbulence by providing smoother edges and recessed piers allowing a more uniform flow of the river.

Because the proposed hydraulic operational system requires significant volumes of water to be taken from and released into the river, it is necessary to develop a system that ac-

complishes this task without introducing additional hydraulic turbulence to the site. This will be done through the manipulation of the river's edge, taking and releasing of water in a gradual manner. The north-eastern edge will be developed as a reservoir providing storage for sufficient amounts of water to aid the bridge opening throughout several cycles. The reservoir will also act as a storm water catch basin in the northern portion of the site and will become an aeration and filtration device to remove pollutants from the river water and storm water run off.

This is interdependency between the bridge and the river, in which the river serves the movement of the bridge and the bridge serves as a valve in a system that will improve the *ecology* of the river.

In addition, the new edge will be developed as a series of hydraulic events acting as an urban educational playground within the program of a *hydric park*: a hydraulic riverwalk which establishes a working relationship between the city and the river and provokes in the mind's eye an awareness of that relationship.

The Miami River lies within the realm of what Gilles Deleuze defines as *The Smooth* and the *Striated*. Deleuze defines the smooth as "a space constructed by local operations involving changes in direction . . . it is filled by events, or *hacceities*, far more than perceived things. It is a space of effects, more than one of properties. It is of haptic rather than optical perception. Whereas in the striated forms organize matter, in the smooth materials serve as symptoms for them...In striated space, lines or trajectories tend to be subordinated to points . . . In the smooth, points are subordinated to the trajectory."⁵

This project defines the river as *smooth* space: a space constructed of a hydraulic-navigational trajectory and of specific haptic uses of those trajectories — it is a space that does not give in easily to perceived forms. The adjacent land lies within the realm of the *striated*: it has been spatially organized in such ways that points formed by the intersection of trajectories are of utmost importance. The river's *edge* is the boundary between the smooth and the striated. The intent of the project is to define the

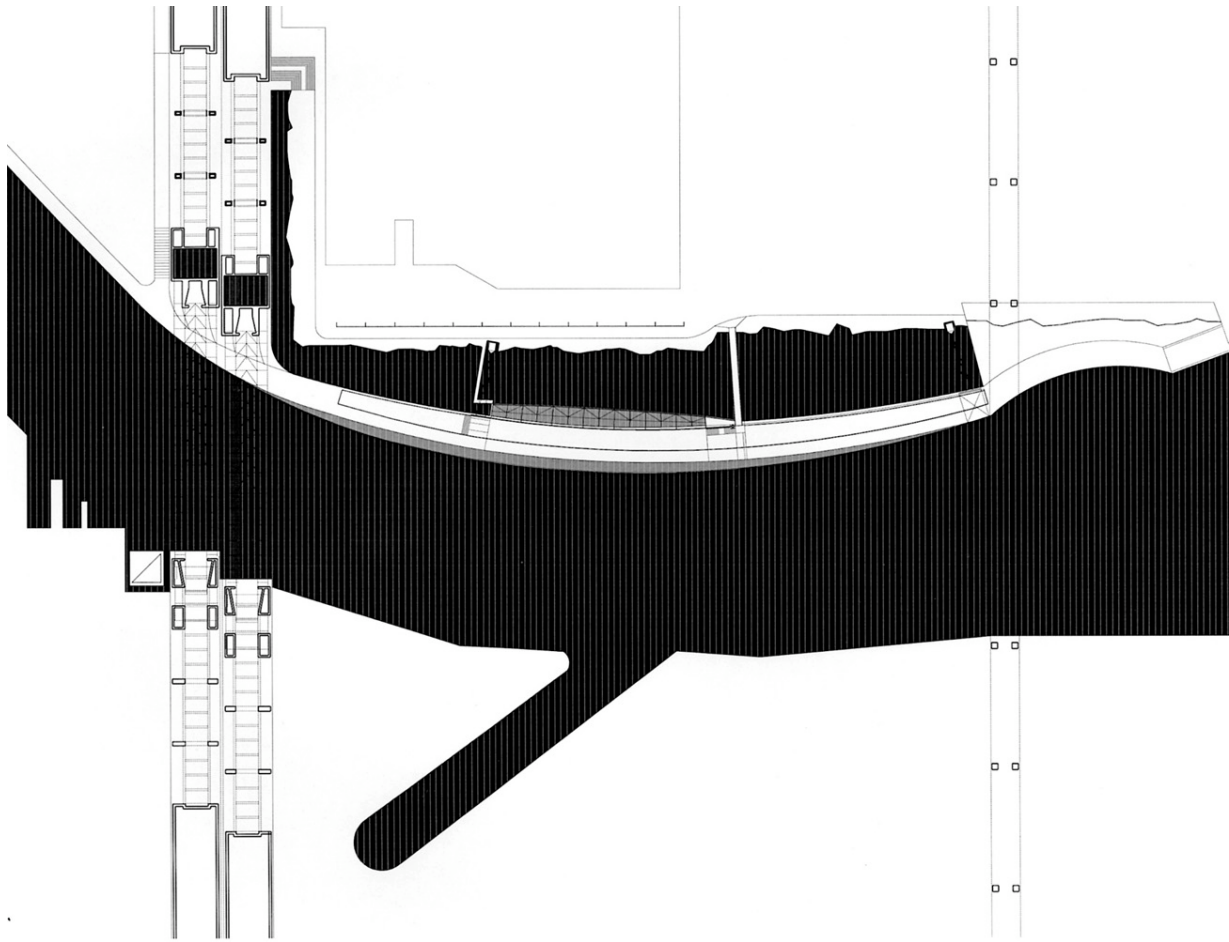
bridge, the condition that lies between the smooth and the striated, as a woven condition. The bridge is intended to be an event in which the river and the adjacent land are hydraulically woven together.



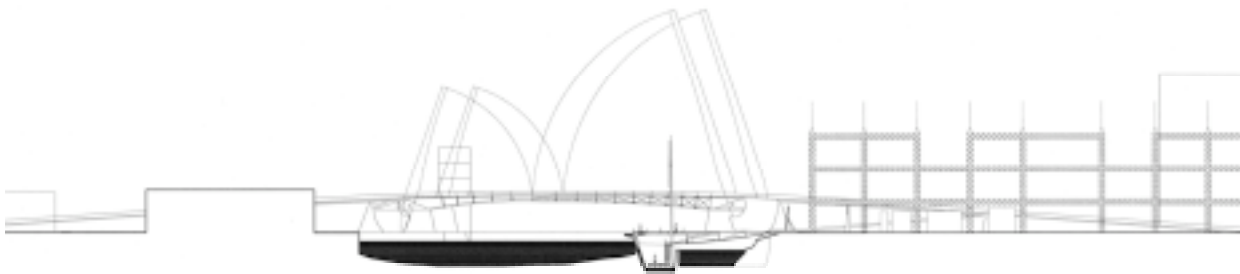
36. Miami River through Downtown Miami, model.



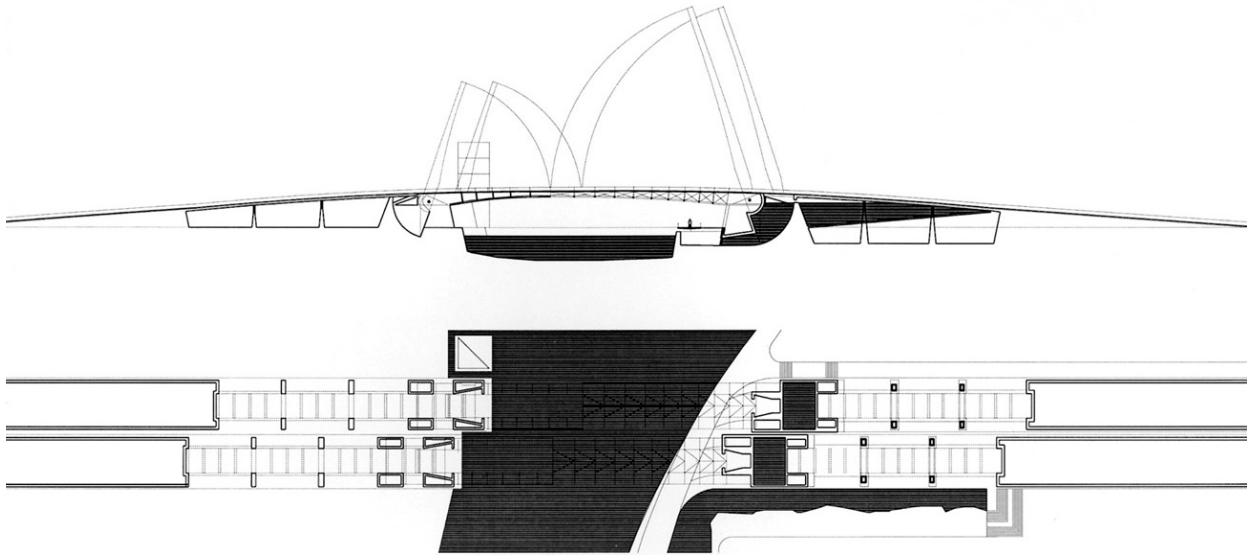
37. Bascular leaf, structural model.



38. SW 2nd Avenue Bridge (left), hydraulic reservoir and hydric park (right), site plan.



39. Section-elevation looking west.



40-41. SW 2nd Avenue Bridge, section looking west (above, plan (below).



42. Existing SW 2nd Avenue Bridge over the Miami River (foreground), and elevated Metrorail span (background).



43. SW 2nd Avenue Bridge model.



44. Miami River through downtown Miami, site model.

Credits

Miami Intermodal Projects
 Álvaro Malo, Architect
 Carlos Zapata, Architect

Miami Intermodal Center
 Juan Linares
 Bayside Station
 Eric Blumberg
 Miami Beach Station
 Hamed Rodriguez
 SW 2nd Avenue Bridge
 Trent Baughn

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Marcus Binney, *The Architecture of Rail: The Way Ahead* (London: Academy Editions, 1995).

Notes

¹ Wallace Stevens, "The Idea of Order at Key West", *The Collected Poems* (New York: Vintage Books, 1982) p 128

² Marjory Stoneman Douglas, *The Everglades: River of Grass* (Marietta: Mocking Bird Books, 1974) p.1

³ Gilles Deleuze and Félix Guattari, "The Smooth and the Striated", *A Thousand Plateaus* (Minneapolis: University of Minnesota Press, 1991) p 474

⁴ David Bohm, "On Creativity", *VIA Vol.2, Structures: Implicit and Explicit*, Publication of the Graduate School of Fine Arts, University of Pennsylvania (Philadelphia: Falcon Press, 1973) p 69

⁵ Gilles Deleuze and Félix Guattari, *ibid.*