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Emergent Morphogenetic Design Strategies

Dawn Gunter

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Emergent Morphogenetic Design Strategies

by

Dawn J. Gunter

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Architecture
School of Architecture and Community Design
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University of South Florida

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Dedication

This Thesis is dedicated to my husband Matthew Gunter, my daughter Phoebe Gunter, my son Royce Gunter, my mother Carolyn Jacobson and my sister Kimberly Jacobson Viteri for the unfailing love and support they offered throughout my Masters.
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Emergent Morphogenetic Design Strategies

Dawn Gunter

ABSTRACT

Emergent morphogenetic designs provide a superior architectural response to programmatic, technical, structural, environmental and spatial requirements that conventional unit based architectural forms are too inflexible to fully address.

Architecture has reached an exciting stage in its development, where structures are attempting to behave more like nature, which does not function as a static state, but as a complex grouping of symbiotic processes which are constantly evolving to adapt to environmental changes.

Digital fabrication and materials engineering have promoted an explosion in formal architectural typologies. By utilizing these digital tools and enhanced materials to embrace a morphogenetic design strategy, architecture can respond rapidly, through multiple permutations to respond to multiple performance criteria. This approach outlines a design process that generates a typology and through multiple reiterations, changes as the design reacts to new performance criteria being added, or the model not adequately meeting the criteria being tested.

The terms used to encompass this new design strategy are emergence, evolutionary optimization or morphogenetic design. This strategy utilizes tools in parallel that have been developed independently by different disciplines, including theoretical mathematics, materials engineering, bio-mimicry, environmental studies and digital technologies.
The site is a parcel located on Tampa Bay at the outlet of the Hillsborough River, where the existing unit based Tampa Convention Center will be replaced with the new performance based Convention Center. The research methods will be simulation and modeling research. This method will start with a performance based program, and submit the models to multiple permutations. Each performance criteria will be applied to develop an iterative process that re-informs the shape, design, structure and materials, and can be evaluated at the conclusion of the design process, testing the accuracy of the Thesis.
Chapter One
Purpose of Project

The purpose of this project is to develop and test a design strategy that replaces the traditional linear unit based design with a reiterative emergent performance based strategy.

Traditional unit based design starts with conventional shapes and extrudes those shapes vertically or horizontally to respond to program and site requirements. A dense site with high sq. footage requirements typically results in an extruded vertical rectangle. A suburban site with high sq. footage requirements and a large campus typically results in a series of long rectangular structures distributed across the site. This process is linear, and the programmatic unit is often at the core of the design decisions. The spatial requirements and the structure may be at odds, but in the linear process, the inconvenience of structural systems is seen as something to be dealt with as one the hardships that must be endured. The reiterative process goes back to re-engineer the structural system to meet the exact performance requirements of the space. The column grid is replaced by a rigorous analysis of supporting the performance required in each space, and structuring the envelope to meet those exact requirements.

Structural analysis and design is one example of the paradigm shift from linear unit based design to reiterative performance based design. The same gaps in the performance of the linear design process can be identified multiple aspects of a project, including urban design, materials engineering, ecological requirements and systems efficiency.
The value of this thesis is to analyze emergent, morphogenetic design, in order to develop a design strategy that utilizes emergent design to address a complex set of performance requirements and generate a sophisticated architectural response that addresses the multiple facets of the complex project undertaken.
Chapter Two
Site Selection and Analysis

The site selected for this project is located in Tampa, Florida at the tip of Tampa Bay where the Hillsborough River empties into the Bay. The site is the current location of the Tampa Convention Center, and is an important pedestrian link between Downtown Tampa, The St. Pete Times Forum - a sports arena, Channelside - a residential and shopping district that also functions as a cruise ship port and Harbour Island. It has views to historic Bayshore Boulevard, a residential area, Davis Island and Harbour Island, also residential areas.

There are 6 hotels currently within walking distance of the site, and a trolley service provides easy pedestrian access as well. The parking currently in the existing

Figure 1 Existing Tampa Convention Center, (Tampa Bay Convention Center July 21, 2009. <http://www.visittampabay.com/images/db/static/conventioncenter/tampaconventioncenter.jpg>)

convention center has a negative impact on the urban qualities of the center, and should be located within the city.
Another critical aspect of the site is the social function of bringing people from many geographic locations together for conventions, social functions, product shows, and sporting events. These functions are socially interactive by nature, yet the size of convention center, and the requirement to have the area on one floor...
makes the interface between an urban environment and a footprint of this size demanding.

Site analysis includes environmental determinants, social interactive zones, pedestrian linkages, visual linkages, transportation linkages and structural requirements.

The first site analysis that was undertaken was to define the environmental requirements of the site, and determine an architectural strategy that responds to the site.

The site is located on a waterway comprised of brackish water resulting from the convergence of fresh water flowing out of the Hillsborough River and the saltwater flowing into Tampa Bay. This brackish water makes the site a perfect location for an estuary. Estuaries support the reproductive cycle of many species critical to Tampa Bay and the Gulf of Mexico. The most important function of an Estuary is the supporting role it plays in the early juvenile stage of marine species development. Without the protective environment of the Estuary, the number of animals that survive into adulthood is greatly diminished. The estuary is the first performance requirement for the site.

Figure 4 The Life Cycle of the Common Snook, (adapted from Lewis et al., 1985)
The key design elements generated by preserving the site's ability to function as an estuary include creating a porous edge, minimizing the building footprint, and maintaining filtered sunlight to support the estuary habitat.

The second aspect of site analysis is identifying the critical pedestrian and urban links, and creating a design strategy to reinforce the urban fabric of downtown Tampa. The sites location between the business district, arts district, sports arena, Channelside, and residential areas provides an incredible opportunity to create a hinge point that connects these areas. The links are indicated by axial lines that slice and bend through the site to define the urban connections that can be reinforced by the design. In the corresponding image, the ground plane is shaded, and carved to highlight potential links. Once the links and subsequent spaces are identified, some are carved into the site and others become three dimensional elements that create the building footprint. The area carved into the site becomes a soft edge that is then analyzed to confirm at least 50% of the site has been set aside as an estuary.
Biomimicry is the final site exploration. How does nature build in environmentally sensitive areas? What structural systems are utilized to create both a porous edge that supports marine life and pedestrian access across the site? The mangrove has been selected as a precedent that will be modeled during the design exploration.

The mangrove will be studied in both plan and section as the design phase moves forward.
Figure 7 Site Plan With Links Carved And Elevated
Chapter Three
Precedent Studies

Four architects and one university research program are important to this thesis because they have integrated digital design, fabrication, biomimicry, materials engineering, algorithmic analysis and structural explorations. The precedent studies include the architects Frei Otto, Lars Spuybroek, Achim Menges and the MIT Emergent Design Group.

Frei Otto

The first architect we will study is Frei Otto. Frei Otto has been a pioneer of bio-mimicry and emergent design since he started the Lightweight Institute in Stuttgart, Germany in 1964. His research and analysis methods are referenced by both Lars Spuybroek and Achim Menges as a starting point in their own explorations.

The three projects of Otto's that are the most influential for our analysis are the Stuttgart Train Station, the Munich Olympic Stadium, and the folded plane diagrams that resulted in dynamic geometric tent structures.

Figure 8 Stuttgart Train Station Underground, (Stuttgart Train Station Underground Hall July 25, 2009. <http://3.bp.blogspot.com/_ScdnDtZTeI/RzoMl5nzdhI/AAAAAAAAATA/2vjMf64L4h0/s400/frei-otto-stuttgart.jpg>
The Stuttgart Train Station and German Pavilion at the Montreal EXPO'67 are examples of rigorous and practical bio-mimical applications of the spider web's structure. A spider's web is engineered to structurally withstand wind, rain, and the intensity of the sun, with the precise amount of structure required for the particular site the spider has selected.

Frei successfully used the spider web in an inverted form to design the Munich Olympic Stadium canopy.
structure and he explored the web as a concrete structure via the Stuttgart Train Station. The key elements that you will find in all three structures include planar warping, algorithmic column grids and integral wind dampers.

The planar warping of the structural system results in a design where every plane is structural, yet no plane functions only as structure. The curve of the concrete and the taut fabric of the canopy also provide shade and waterproofing. The algorithmic column grids are critical, because in all systems, the column are placed only as required. What could be misinterpreted as random placement, is actually a rigorous system, that has provided the exact bearing required to support the system in the most ideal structural location.

The vents in the canopy and concrete structure of the station function as wind dampers, allowing a free flow of air that provides natural cooling and greatly reduces the structural requirements.
The diagram that is most relevant to this project from Frei's work is an analysis of the mangrove structure, that sits on the water’s edge, embracing the soil, providing a wildlife habitat, shade for marine dwellers, and a structural system that provides stability against the wave and tidal surge that continually barrages the shoreline.

Another diagrammatic study is the carving of the site to create a porous edge. The bay carves an edge that maintains the urban relationships and the supports the existence of an estuary. The hard edge of the existing convention center is changed by the performance requirement of the site to function as a sustainable habitat.
Lars Spuybroek

The second architect that is relevant to this thesis is Lars Spuybroek and his design for the Pompidou Two, an invited competition to design the second Centre Pompidou for the City of Metz, France.

Spuybroek selected balloons of two unique colors to represent the size and desired opacity of the interior spaces. The balloons were strapped to a board with black straps. Additional strapping was added to prevent the balloons from falling out. Spuybroek states that "We now have a portal structure (with its typical hierarchy of primary and secondary elements that transforms into a shell structure (without that hierarchy) to create local deformations of volume (No. 305).

The balloons define the building's shape, the straps become the structural ribs, and the opacity or transparency of the skin is determined by the location of the two unique balloon colors. The skin follows the interior program.
The shape of the interior spaces and columns.

Figure 16 Pompidou Two Study Of Opacity And Transparency Of Skin (Nox, Pg 320-321)

Figure 15 Digital Balloon Outer Skin Analysis (Nox, Pg 306)

Figure 17 Pompidou Two First Exhibition Level (Nox, Pg 333)
were determined by a second modeling study. In this study, the strapped balloon shape was enclosed in an upside down box shaped like the exterior skin. Plaster of Paris was then poured around the balloons until the shape was full. The plaster was allowed to dry, and then the balloons were removed. The remaining voids defined the interior, and the remaining plaster ribs defined the structure.

The resulting building is constructed of gently curving interior and exterior walls that are rarely planar. This provides a continual surface for artwork at the interior, and provides light to the public interior spaces throughout the day. At night the building glows in different colors, functioning as both artwork and an urban connector to the community.

The key diagram that Nox’s Pompidou Two provides for this project is the singularity of program, skin,
structure, and shape. This commitment to designing by overlaying multiple complex performance requirements that are all encapsulated in a single elegant formal response will be carried into the design phase. Achieving this singular response will be a critical judge to determine the success of this project.

Figure 19 Pompidou Two Interior Gallery (Nox Pg 316)
Achim Menges

The third architect critical to this Thesis is Achim Menges, the director of the Emergent Technologies Design Program at the Architectural Association in London, and one of three principal's of the Emergent Design Group.

According to Menges, there are three measures that we can use to generate and qualify emergent designs. These are ecological, topological and structural provisions. Ecology refers to all the relationships between human groups and their physical and social environments. Topology is introduced here as the connections between all the material elements in an environment. Structure refers to organisational capacities above and beyond load bearing. In this way, ecology, topology and structure are inseparably intertwined (Emergence: Morphogenetic Design Strategies, pg 83).

These three measures will be key for the analysis, design and testing of this thesis. In the shift from a unit...
based linear design process to a performance based reiterative design process, ecology, topography and structure will function as the basis for design, research and final analysis.

The project of Menges's that incorporates these three measures is the Postagriculture project, a research study for the design of a large-scale agricultural production facility in the Netherlands. A key similarity between the Postagriculture project and this Thesis is the goal to "spatially combine activities that appear to be incompatible (Emergence: Morphogenetic Design Strategies, pg 83).

The first performance requirement is the sustainable food production or greenhouse activities. The second performance requirement is the urban interactions. These two items generate the performance criteria for this project, and begin to define the ecological, topological and structural aspects that the design will incorporate.
The first two images are analysis of the differing light levels required in the two distinct performance areas of the project.

The third image represents the structural response to the parametric requirements that include internal pressure, the pre-stressing of the membranes, and the resulting seam layout at each of these points.

The roof membrane is the result of reiterative analysis that create the shape, opacity, structure and volume simultaneously by incorporating the ecological, topological and structural elements.

The squares that are represented in the schematic site plan morph into completely different shapes as the reiterative performance requirements generate the projects form. This morphing of the unit based element into the ecological, topological and structural form is the diagram that articulates the essence of Menges's influence on this project.
project. The same rigor of performance will be used in this Thesis to generate and reiterate the space, structure and connections until the final formal conclusion is reached.
Chapter Four
Convention Center Program

It is important to note that the traditional unit based program is superseded by a performance based program. The individual units required to construct the project become secondary and tertiary elements. The ways in which the project is to perform are the primary considerations. The units that the project is constructed of are the one primary element remaining from a traditional program. The following outlines the performance based criteria that will generate the design, and will be broken down into three main categories, Ecology, Typology and Structural.

Ecology is defined as - "The relationships between groups and their physical and social environments." (Menges pg 81) We will explore Topology -as "Connections between all the material elements in an environment." (Menges pg 81) Finally, Structural connections are ““Organisational capacities above and beyond load bearing.” (Menges pg 81)

The criteria listed below fall under the ecology requirements, and have an even greater impact on the articulation of the project than the standard unit based program, which will be categorized under Structural. The first ecological requirement is the functioning of the site as an estuary - Fifty percent of the site should function as soft scape, restoring the shoreline to its original function as an estuary.

Pedestrian Links are another critical ecological requirement - The site is at a critical juncture between downtown Tampa, The St. Pete Times Forum, a hockey, basketball and concert venue, and Channelside District, a
high activity area including cruise ports, residential, retail and and the Tampa Aquarium.

The City of Tampa has required that all new development incorporate a riverwalk that will provide continuous pedestrian access between each site along the length of the Hillsborough River.

In summation, these multi-dimensional links should support the following connections: a pedestrian link between downtown Tampa and the waterfront, a pedestrian link between downtown Tampa and the St. Pete Times Forum and Channelside, an environmental link between convention attendees and the local environment, a visual link between the events at the Convention Center and the unique districts of the City of Tampa.

As defined earlier, Topology will be programmed and analyzed as the "Connections between all the material elements in an environment." These connections are the elements that site the Convention Center to this particular location in this particular city.

The hard edge at the waterline should be replaced with a porous edge over the maximum amount allowable of the site.

The opacity of skin should vary according to the interior functions, but there will be a commitment to unlight the building, rather than create a black box that requires artificial lighting for all occasions. There are a number of technological advances, such as glass that becomes opaque when a charge is placed on the glass. Also, with the advent of better electronics and shades, there are many extremely successful options for blocking daylight for the limited venues that require a black box.

A critical side-effect of the transparency of the skin, is the visual link achieved by varying opacity levels of exterior skin. The life of the building can be seen from the
city. Loading and unloading of new conventions and the change of the structure when it is blacked-out create a critical communication between the city and the center.

The final programmatic category is Structural, which we have defined as "Organisational capacities above and beyond load bearing." This is where we locate the traditional unit based program requirements. The building will have an overall sq. footage requirement of 600,000 sq. ft.. This will be utilized as follows.

A pre-function space of 80,000 sq. ft., including a 21,700 sq. ft. registration level shall be provided for convention attendees to register and purchase tickets for the various events.

The exhibit hall will total 200,000 sq. ft. with 118,800 sq. ft. completely unobstructed. The exhibition hall must be divisible into 75,000 sq. ft., 100,000 sq. ft. and 125,000 sq. ft. sections, and the entire hall must have a minimum 30’0” ceiling height.

Within the hall and the support spaces, there must be the capacity to support the following: 1,000 10x10 booths, a loading docks for up to 22 tractor trailers, direct access via three separate loading dock doors, telescopic riser section seats for general sessions and entertainment configurations, show offices available, concession areas and floor load capacity of 350lbs. per sq. ft..

A ballroom shall be provided to total 40,000 sq. ft., divisible into four sections with a minimum 19’10” ceiling height. The layout of the ballrooms needs to accommodate general sessions for 3,600 people to meet and have video and speaking presentations comfortably. In addition, complete food service and preparation shall be located adjacent to the ballrooms with serving connections.
Breakout Rooms need to be provided with a minimum of 36 rooms, a minimum of 10 are to have waterfront views.

Outdoor Space shall be provided in the form of a riverwalk, overlooking the water at 14,600 sq. ft with an adjacent area provided for evening receptions and banquets. A Garden shall also be available for receptions for up to 500 people.

The main electrical requirements are focused on the Exhibit Hall, which requires that utility services are delivered through flush mounted floor boxes on a 30’ x 30’ grid. The service must include both 120 volt, 1 phase with 20 amp capabilities, as well as a 120/208 volt, 3 phase, 4 wire with ground and 1 receptacle with 100 amps 208/480 volt, 3 phase available at 60’ on center within the 30’ grid.

The building footprint shall be situated to reduce the impact of building footprint by elevating the main structure, and the structural system shall be engineered to create a minimal interruption to the ground plane at grade.
Chapter Five
Initial Design Concepts and Investigations

The initial design analysis consisted of two tasks; to define the ecological, topological and structural requirements of the project, and to generate a design concept to provide a framework for the analytical responses. The ecological requirements which are defined as "relationships between human groups and their physical and social environment" include the creation of an estuary, identifying and reinforcing urban links, both spatial and visual, and the integration of the riverwalk into the project. The topological requirements which are defined as "Connections between all the material elements in an environment" include the porous edge at the waterline, opacity and transparency used strategically to connect the interior functions with the urban environment, the shape and orientation of the structure to minimize the cooling requirements, a visual link to the districts surrounding the site, and a functional connection to the roadways the intersect and surround the project.

The structural requirements which are defined as "Organisational capacities above and beyond load bearing" include minimizing the building footprint, engineering the...
structural system to create a minimal footprint at grade, and exploring a space that can be conditioned and covered, but has circulation and break-out spaces that are open to the environment.

The design concept for the project is the framework that ties the performance requirements together and gives the project its soul.

The concept should both reflect and delineate many of the performance requirements for the project. The concept for this project is breaking waves. This concept is multifaceted, and should influence the form, the way the light shimmers across the structure, and the partitioning into one large structure broken down into many related parts.

The final initial analysis the end user of the convention center. The Tampa Convention Center is unique, in that not only does it pull people in for conventions from the state, the nation and the world, but it also has a front row seat to the Gasparilla Festival, Dragon Boat races, rowing events, and is an important pedestrian link between hotels and channelside and the sports venues.

Once the original analysis and performance requirements were in place, the next step was modeling the performance requirements to begin the reiterative phase of the design process.
Chapter Six
Preliminary Schematic Design

The analysis phase resulted in a series of diagrams generated by the precedent studies, and a set of figure grounds that articulated the locations of potential site carving, urban links, and locations for the structure.

The program was also analyzed to generate the unit based requirements, and their potential distribution over the site, similar to the Postagriculture Site Plan. The first sketch model stacked the programmatic elements, liberating as much of the ground plane as possible. The second sketch model started at the ground plane, and began a subtractive process that carved into the site to eliminate the hard edge at the water, and began to create the portion that would function as the estuary. The unit based areas that had been stacked in the first sketch model, but in the second model became a series of

Figure 28 Stacked Programatic Elements
dissected planes, to allow sunlight to filter down to the water below. The models were then photographed to determine how much of the estuary below received the filtered sunlight.

Another analysis undertaken during this phase was to evaluate the program elements, and their impact on the urban fabric. The parking required by the program was omitted, due to the negative impact on the convention's center ability to function as a pedestrian or transit destination. The parking for the convention center will be located within the city's public parking areas. This reinforces the pedestrian traffic to and from the Center, and allows visitors to utilize the trolley and bus systems set up to service the Convention Center.

The shape of the exterior skin was also modified from the first to the second sketch model. This was manipulated to study the impact on the light bending around the structure, and providing natural light at the riverwalk that flows beneath the structure.

Figure 29 Stacked Articulated Programmatic Elements
The model was scaled, and the area of each plate was verified. The pre-function space was inadequate in the sketch models, and must be revised for the next modeling phase.

The next analysis phase studied the opacity of the materials, the light filtration through the spaces, minimal structural analysis, the pedestrian experience and a verification that the program was fully met within the building footprint modeled.

Particular attention was paid to the ground plane during the modeling and subsequent analysis. The primary goal was to locate programmatic elements on the ground plane that would activate the pedestrian and urban realm, and to locate the functions at the ground plane that were required programmatically. The water’s edge was pulled to the very front of the site to identify the location as
waterfront at the building point of entry, thus reinforcing the marine link.

The skin's transparency and opacity was schematically modeled to connect the interior functions with the exterior urban element.

The parking was removed from the model, but the loading docks were modeled to verify that they met the programmatic requirements and could be elevated above the ground plane.

The roof was raised to provide shade for the afternoon sun, and the 4th floor pre-function space absorbed within the building envelope by the cascading roof plane.

The fourth analysis phase will include a modeling system in which the skin, structure and exterior and interior spaces are defined by one simple formal response that responds to multiple stimuli.
The site will be modeled in sectional slices that demonstrates and analyzes structure and skin combinations, and studies the best system to achieve the spans, provide an adequate level of daylighting, functions as an activator to identify the interior activity to pedestrians on the exterior, and activates the ground plane.

The project will also be modeled using Revit, or a similar 3-d modeling tool that can undergo multiple permutations as the model reacts to external stimuli.

These next steps will be undertaken beginning in an independent study that focuses on the sectional qualities of the analysis process in Revit modeling, and culminates in the physical modeling during Thesis II.
Chapter Seven
Design Development

The Convention Center design produced during the schematic design phase was analyzed for its compliance with the ecological, topological and structural requirements outlined in the program.

There were a number of requirements that were not fully satisfied. The two main unresolved requirements include the activation of the ground plane, and the scale of the convention center relative to the city grid. While the building was elevated above the ground plane, there were no programmatic functions to activate the ground plan. The space below the convention center would function as a large plaza without pedestrian life.
The second main unresolved requirement was the scale of the urban grid relative to the scale of the building. The convention center footprint is too large when articulated as one contiguous structure. The Convention Center disrupts the grid, and the schematic design was not porous enough to create the links required to successfully respond to the urban site.

A new intervention was explored during the Design Development phase to address these failures identified by analyzing the ecological, typological and structural functioning of the schematic design.

To address the overwhelming scale of the Convention Center, O.M.A.’s Competition Entry for Parc de la Villette was studied as a precedent. Rem Koolhaas identified the main design challenge to be the scale of the parc relative to the city of Paris. To address this, Rem Koolhaas divided the Park into programmatic strips that allowed the pedestrian to enjoy a series of discoveries as they experienced the park. The programmatic strips reduced the scale of the site, bringing the project in-line with the scale of Paris.

The initial hypothesis for the Tampa Convention Center, is that the Convention Center is footprint too
large for the fabric of Tampa’s urban grid. The hypothesis diagram illustrates the size of the program, relative to the size of the standard city block.

To successfully integrate the Convention Center within the urban fabric, the footprint must be articulated and reduced. The hypothesis also addresses the site’s location as environmentally significant, and notes the lack of pedestrian density and pedestrian activators around the existing convention center at the public realm.

To address the requirements in the hypothesis, the design will use the same principles that nature uses to integrate with varied habitats. The design should emerge from the constraints of the site, and should morph to become what is required to live successfully at this location.

From this, the concept of Porosity was developed, meaning that the building should function as a porous or

Figure 40 Hypothesis
permeable organism that is less about the built form and more about the actions that occur in and around the distinct parts. The program elements were diagrammed, separated and elevated to become porous and assume the scale of the urban fabric.

The bands begin to fragment the scale of the overall site to respond to the city fabric and provide a structure that facilitates the flow between the elements. Each band represents a unique programmatic element that can transform over time to respond to the changing needs of the city.

The following series of diagrams identify a series of events that impact the bands, and define how the built form is anchored by or influences the bands.

The Links diagram represents the links that should occur between the site, or bands and the surroundings.
The links are separated into three different levels; global, local and micro.

The global links include those that occur beyond the site, such as the pedestrian links from both Tampa and Franklin Street. Transportation is also a critical global link. To address this, all parking is located just to the north of the site, where attendees must leave the vehicle and enter along Franklin Street. This activates the ground plane and encourages attendees to utilize the trolley, taxi and bus systems to arrive closer to their destination.

The second set of links are the local links. These occur within the site, and include circulation paths between the individual programmatic functions and the need to efficiently set up and break down between conventions. This also addresses the points where the elevated convention center intersects with the bands and touches the site.
The third category of links occur on the micro scale. The materials that comprise the skin, the structure and the floors are all micro-links that link the building to the site on the material level, and define the building's ability to function in a sustainable manner.

Access and circulation nourish the site and support all of the systems that interact with the site. This is the next series of events that articulate and influence the bands. The main access points to the site are identified as visual, physical, psychological, and environmental.

The two main physical connectors are the boulevard and promenade. These tie all of the unique programmatic functions of the bands together. The boulevard is programmed to be a 24 hour space, with a continuous cycle of urban functions that mark the progression of the day, and have a corresponding urban function that activate the ground plane. The boulevard
also restores an important physical and visual link from Tampa street into the site. The original Tampa street is restored, and connects pedestrians to Ashley street, which turns to run east west along the river, and connects the convention center to Channelside.

The promenade occurs along the riverwalk, and provides a more leisurely way of experiencing and interacting with the bands that penetrate the site.

The Moments and Voids are the points at which the building and other programmatic elements interrupt the bands, or the ground plane comes up to meet the building. The design becomes a figure ground in which the static programming elements are held constant and the design occurs in the voids and links.

The design and experience of the building occur around the static programmatic elements of the convention center, and the success of the thesis will be evaluated by
how well the building that emerges has responded to the external stimuli.

The final diagram is the overlay of the separate diagrams of Porosity, the Bands, Links, Boulevard, Promenade, Moments and Voids.

Based upon the rules established from these Design Development Diagrams, the reiterative exploration of the built response will be generated. The next step will be a series of models that test the diagrams in 3 dimensional form.
Chapter Eight

Design Exploration

The final test of this thesis is the Design Exploration Phase, where the emergent morphogenetic characteristics of the built form are modeled and evaluated. There are five exploration models that maintain viable design responses from previous analysis, and replace unsuccessful resolutions.

Exploration One

The first exploration models the bands, links, moments and nodes. These bands establish the organizational framework for modeling the Convention Center.

The pedestrian link between Tampa Street and Ashley becomes a major datum line throughout the site, and re-establishes an important global link for the city.
Exploration Two

The second exploration models the Convention Center, which is both imposed upon and carved by the bands, nodes and links modeled in Exploration One.

The concept of porosity is explored by dividing the footprint of the convention center into smaller spaces and elevating them. The distinct areas will be connected by elevated links in a subsequent model. The river’s edge is carved to correspond with programmatic elements that occur within the bands.

Freight delivery, stacking and parking are all pushed to the north of the site and elevated, forcing pedestrians to experience the site from the street level, and removing the large scale functions of semi-trailer loading from the pedestrian environment.

The ground plane is given back to the city as a park, and the bands correspond to different functions within the park. The maple, cherry and balsa bands correspond to
soft-scape such as grass or garden environments. The black, charcoal and gray bands correspond to hard-scape such as play courts or swimming pools.

Exploration Three

The third exploration models the links between the individual convention center nodes, the freight and parking nodes and the pedestrian level.

The white indicates the links, and nodes, and the cherry represents the moments. The convention pods are modeled in Ash.

At the center of the model is a garden that carves through the building. Secondary links that allow attendees to move between the individual convention spaces run parallel to the primary axis, and the nodes that intersect with the ground plane are located at each individual pod.

The model functions as a figure ground to the next exploration which will absorb many of these functions into the massing of the building, become secondary spaces.
Exploration Four

The fourth exploration models the Convention Center developed in explorations two and three, but jumps up in scale and further develops and explores the spatial qualities of the program at the ground plane.

The ground plane is modeled as an aquatic center, a public garden, a marina and a plaza. The garden no longer has such hierarchy within the campus, but carves only the ground plane adjacent to the interior waterway.

The building intersects the ground plane at the entry to each convention pod, and also at restaurants and bars located along the Riverwalk.

The pedestrian and freight delivery links are absorbed into the building on the upper levels, as well as the links between the individual convention pods.

The roof plane is carved to reflect the edge of the river below, and identifies areas where the roof and floor...
structure should be constructed of different materials to allow light to penetrate to the river below.

The carving of the river extends to Franklin Street, which identifies the site as riverfront immediately from the initial pedestrian approach. This also expands the area that can be planted with marine grass, and function as an estuary.

The convention center level is comprised of two larger areas and two smaller areas. These can be utilized to host one large convention, two conventions, or four smaller conventions. The bridges between the centers allow circulation within the conferences, and between the reception areas to the street.

The ballroom and meeting rooms are suspended below the Convention Center and the columns to support the structure are located at the intersections between bands.
This design was presented at Thesis Defense, and a number of weaknesses with this exploration were identified.

The first concern is the horizontal nature of the structure in an urban core that has density goals more suited to a vertical structure that will add density.

The second concern was the plaza between the center and Franklin Street. This is an important street edge at the intersection of the downtown core, Channelside, Harbour Island and Bayshore, and needs to activate the pedestrian link between these districts.

The treatment of the roof plane, and the potential to create a green roof, which will function as another civic space was identified. The ground plane and the restaurant/bar nodes that intersect at the Riverwalk may lack the density to activate the Riverwalk to its full extent.

Exploration Five
The Fifth Exploration, in response to these design deficiencies, adds a hotel tower, a residential tower, open air shops and restaurants along Franklin Street and raises the ground plane to the south to meet the public rooftop terrace of the first convention center pod.

The park below the Convention Center is replaced with shops and office space along the interior waterways. The rooftops all become terraces to serve the towers, and the ballrooms and meeting rooms are stacked above the convention center pods to make strengthen the interior/exterior connection, and utilize the rooftop terraces for convention center attendees.

The arrival sequence is refined, to allow entrance to the center at the north and south of the site. Guests then take escalators to the pre-function space at the third level to attend receptions at the indoor/outdoor space, and purchase tickets to their desired function.
A second set of escalators take guests to the convention level, and the links between the pods have been enlarged to enhance social interaction and provide additional exterior booth space between the convention pods.

The ballrooms are located above the north convention pod. The roof is angled up to maximize the view towards Tampa Bay, and along Bayshore, and the convention center is again utilized as a green rooftop terrace.

The hotel is located to the north of the site, and is the taller of the two towers, to service the conventions, nearby sports venues and business travelers to downtown Tampa.

The smaller tower is residential tower, with 10 floors of units, and a top level with suites and public spaces. Each tower has a private terrace above the fourth floor.
meeting spaces, consisting of a pool, hardscape and softscape.

The links are constructed of translucent material to allow light to filter down to the marine habitat below, and the estuary’s cuts into the site have been enlarged to allow more sunlight to filter between the buildings.

The four separate convention pods have been combined into three, and their footprints are determined by the site dimensions. The convention center areas above the interior waterway are constructed of translucent concrete, allowing a soft light to filter down to the shoreline below the overhang.

There are cuts in the edge to the south and north of the site, to allow a vehicular drop-off. With the exceptions of those two cuts, the site is completely dedicated to the pedestrian realm.
The towers are a combination of residential and hotel programming, to serve the convention center, and activate the site during non-convention periods. They also bring verticality to the site, which differentiates the Tampa Convention Center as an urban development.

Most aspects of this exploration were successful, with the exception of the ground plane. The previous park scheme from the initial developments was reintroduced in Exploration Six.

Exploration Six, a section cut at 1:30 was the final exploration.

The main goal of Exploration Six was to understand the building in section relative to the critical edges of the site, including the pedestrian edge created along Franklin Street, and the public/private edge that penetrates the building from Tampa Street.

Transparency, translucency, and opacity are also important factors in this exploration. The essence of this
design is found in the spaces that surround the building, as much as it is found within the building. As in the original concept of Porosity, it is the action that the building supports that is the essence of the design. There are a number of zones that this exploration tests for compliance to the original concept and Thesis.

The first zone is the pedestrian edge along Franklin Street. The goal for this space is to be the most permeable, activated edge of the site. The 24 hour cycle of urbanism is played out along this open air market/retail space.

Residents and visitors leave for their sunrise jog, friends meet to share coffee at a streetside café, and delivery trucks double park to unload their deliveries.

At mid-morning, the casual streetscape is replaced with convention goers in company logo golf shirts, cheerleading uniforms, power suits and pedestrians. The
At noon, both edges of the site come alive, as café’s along Franklin Street and the Riverwalk fill with people both local and non-local, creating a diverse urban community. The elderly attend water aerobics, local college students jog through, and the suits from downtown populate the restaurants and café’s.

The afternoon belongs to all edges of the site and building simultaneously. Rowers arrive for practice at the south edge of the site. The aquatic center comes alive at the North edge. The Convention Center begins its gradual transition from inward focused to a living pulsating being within Tampa. The market is populated by shoppers, senior citizens meeting for the afternoon, and children out of school, enjoying the afternoon of freedom, until their parents arrive and begin the evening routine of all things responsible.
The evening is experienced along the site vertically, as the tower, hotel and street edge come to life simultaneously. Bars fill with convention goers that meet old friends, and make new ones. The market transitions to a peaceful edge with points of activation.

The hidden freight link between the loading dock and the Convention Center glows with activity, providing a visual link between the Convention Center and the city.

The site becomes a porous interface between the city and the riverfront, and re-establishes the convention center as a truly urban centerpiece.

The waterfront now has shallows and grasses that support marine life, but the city also enjoys the life-giving function that the Convention Center, Hotel, Open-air retail, Condo tower, restaurants, cafes’ and park brings to a city.

Figure 65 Ground Level Plan
The floor plans offer an understanding of the program assignments, yet it is in the in-between that you will find the essence of this design.

The ground plane to the south of the building rises up to meet the first Convention terrace. The rowing club can support visitors from around the world, as they enjoy the beauty that Tampa Bay and the Hillsborough River bring to our City. It is an incredible unique experience to enjoy such peaceful natural surroundings in the middle of a large city.

The aquatic center is open to swimmers of all ages year around, and can host swim meets to talented young athletes from around the world.

Small Café’s dot the riverwalk, serving the park, Convention Center and City beyond.

The Convention Center level is extremely simple in its form, but the slices between the rectangles make attending a Convention in Tampa unique from many Cities, in the way you circulate outdoors between convention
booths, allowing for a beautiful expansion and compression of experience as you experience conventions.

The pedestrian/ freight link and sun decks are all constructed of translucent material to bring sunlight to the water, and sustain the life below. The architectural effect of this is a series of ethereal planes floating above the water.

The footprints of each level, and the edge of the water create a tension of hierarchy, as a site that is carved both vertically and horizontally to support multiple functions at once.

The ballroom and pre-function level have amazing views of Tampa Bay and the surrounding community. The Pre-function space can be utilized as an indoor space, a combination interior/ exterior, or completely exterior. This
gives the Convention attendee multiple experiences with the natural settings of Tampa Bay.

The ballroom is designed to maximize the views, and flexibility of interior layouts, while providing complete access to the surrounding rooftop terrace.

The translucent connector between the ballroom and pre-function space allow guests to feel the impact of nature on the structure. The classrooms, hotel and condominiums float above this level.
Figure 69 Fifth Level Plan
Chapter Nine

Conclusion

In conclusion, the Tampa Convention Center was an important vehicle to test the thesis due to the complexity and inflexibility of its program. Suprisingly, the most complex exploration provided the most elegant design solution.

A convention center presents a difficult urban challenge, as does bringing nature and dense populations together.

Cultures that thrive often do so, because they are comprised of a rich and diverse blending of knowledge, beliefs and customs. Understanding architecture’s part in weaving this cultural, bio-diverse fabric is the next great challenge for this century.
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