The Aggregate of Continuum

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Abstract

The Traversable Matrix (Fig. 1.) illustrates the iterative fragments that comprise the continuum of exploration for a digital aesthetic and digital tectonic. These non-hierarchical fragments operate as footholds across a larger tessellated landscape of current digital design explorations. In seeking an organizational strategy, we attempt to move laterally across a variety of examples, texts, and illustrations. Each short excerpt is a partial architecture illustrating deeper issues in the current discussion of digital fabrication. Though counter to conventional academic inquiry, the associative approach can help frame the matrix; the synthetic landscape traversed becomes less linear, less framed but no less interconnected and cohesive. The patterning of complex geometries, the production of ornament, the leveraging of digital fabrication against standard forms of material and construction practices, and the acute emphasis on surface all serve as the aggregate to a broader spectrum of architectural thinking and architectural making.

Introduction: The Traversable Matrix

The Traversable Matrix of partial architectures suggests an organizational structure of manifold influence and interest. These interests are not overtly digital in origin but are instead more subverted and even contorted by digital design methods. Because no definitive end is pursued, the fragments comprising this work collectively deal with technique and effect as opposed to process and conclusion. Whereas process is the revealing of a particular set of internal steps or iterations leading to a conclusive outcome, technique is the revealing of method having multiple manifestations with no particular conclusive outcome.
To that end, these excerpts are to be read as sketches attempting to illuminate experiential fascinations in an unfinished story.

While the capacity to move across various 2D and 3D design platforms suggests a new type of agility for architects and designers, this capability is still largely in an early state of gestation. So what role will the incomplete, the partial, or the ‘not yet fully formed’ play in developing the evolution of digital fabrication? Is it possible that incomplete in this sense does not reinforce the divide between digital and analog but rather transcends it all together? The effect created or the effect observed becomes the most tangible result of the partial architecture. Themes of light, surface, materiality, and tactility are all momentarily suspended inside the examples, texts, and illustrations found in the Traversable Matrix.

It is a strange impulse to suggest there is a point of distinct origin for terms like digital design and digital fabrication. We offer terms like 2nd and 3rd generation to indicate the evolution of ideas, methodologies and architectures to seemingly bind ourselves to an origin. Possibly we offer a sort of homage to those who have pioneered certain territories or held academic influence over us while in our initial stages of education. In many ways this type of positioning is the nonsensical rush toward an ever-elusive novelty. The emphasis on novelty, while a much-celebrated tenant of early digital discourse, is of less importance in this work and is in many ways now eclipsed by issues that already have a long standing history within the architectural discipline. Terms like ornament, tectonics, materiality, phenomenology, and even aesthetics, are of greater interest in this matrix. As these issues continue to gain momentum within the evolving discourse of digital fabrication, we will be challenged to broaden our perspective to include issues of digital discovery as well as issues with a distinct historical trajectory. The Traversable Matrix that follows aggregates a larger continuum of thinking and the exploration of partial architectures.

Ethereal Topographies

Looking out the window somewhere at about 20,000 feet the transformation is now undeniably obvious. The landscape that held wrinkles, folds, dots of water, and even a pictorial cultural history has now vanished. Replacing terra firma is now an indeterminate, rolling sea of clouds. The new cumulous landscape is subtly shifting and transforming into more of the same with the threshold of final formation never quite reachable. The familiar game of projecting forms and faces onto the ephemeral surface suggests a desire to apply a narrative onto the elusive and intangible surface. For a brief time this surface is penetrated and outside becomes inside – the exact moment of exchange not entirely self evident. The ability to project forms and faces is suspended and only
the refraction of light is left as a guide to the other side. Feelings of disorientation and confusion are mixed with wonder and childlike amazement. And then as suddenly as outside became inside the process is reversed and the threshold of surface has once again been transcended; still there is no greater clarity of when the crossover happened. The fluidity of motion is essential to the poetry of the experience.

As the plane climbs to 32,000 feet a second reference plain appears clear. Perceptions of in, through, and next to have now been exchanged for above. The new topography below is now ethereal and illusory. Cartesian mapping strategies no longer seem effective to quantify this new landscape. While the new landscape projects a majestic quality, there is also a sense of instability and temporality that is tangible. The only reference point left to anchor to is the horizon that extends endlessly across the sky. The datum stays exactly equidistant between the certainty of our own existence and that place that never arrives. It is this perfect splitting of distance that we have subconsciously learned to count on for stability. Held no longer by what is quantifiable, we acquiesce to the theory of mathematics. No longer holds the abstraction of numbers to come – n is the number. The absolutes are exchanged for relational proximity. But will this sustain us in the future? How will we locate ourselves on the ethereal topographies of tomorrow? Will we accept technological acceleration and information the way we have come to accept gravity? Will Virilio’s Open Sky become our conceptual roadmap that we reference when deciding between a left and right turn in this new landscape?

Reverse vertigo that may well force us to change the way we think about the landscape and about the human environment. So not only has our generation just discovered a hole in the thin layer of ozone that once protected us from cosmic rays; it has also just poked another one in the blue, for, from now on our sky is vanishing. The vanishing point at the horizon of the Quattrocento is now coupled with that of the Novecento: today, there is a way out up above. An artificial counter-gravity allowing man to shed telluric gravity, the stability of gravitational space that has always oriented man’s habitual activities. Everything is being turned on its head at this fin de siècle – not only geopolitical boundaries but also those of perspective geometry. Arse over heels! Appearances generally and those of art in particular are being deconstructed – but so is the sudden transparency of the world’s landscape. Soon we will have to learn to fly, to swim in the ether.

(Virilio 1997)
Choreographed Ergonomics

The undulation of the surface shows the visitor where and how the body should position itself; yet nothing can ever be completely scripted. There is the in-between, the hump, the unexpected, and there is also the narrative.

A young woman tragically dies in an accident. Her life—a testimony to freedom and exploration—ends far too soon. Her absence is always present. The surface waits in anticipation of her arrival. She is never too far away, but she is never quite there. And the surface also anticipates the arrival of her loved ones who make the annual pilgrimage. They come to observe the presence of her absence. The choreography whispers in their ear, but not too loudly. They prefer to gaze across the water and look for a new horizon, a new datum, and transference. In the end it is simply a quiet moment to sit, to recline, to observe, and to reflect.

Work posture: 0° to 5°, Alert postures: 5° to 20°, Relaxing postures 20° to 30°, Reclining postures 30° to 45°, Medical uses: over 45° (Note: headrest required over 30°). (Ramsey and Hoke 2000)

The tragedy of loss produces the need for contemplation and reflection. It is the threshold of a pragmatic poetry. An unexpected site reveals striation, carving, digging and the enduring presence of water for thousands of years. A dance is created and it is the fluid amalgamation of one body at one moment, linked through time with other bodies finding position, finding respite. It is a liturgy for one, but a story for many.

Ergonomics are choreographed and mapped not for efficiency, but for fluidity. The surface is made of striated pieces of Brazilian hardwood that choreographs the ensemble like Muybridge’s horse or like Duchamp’s nude. The surface is presented for quiet reflection and is located close to the edge of the water, perched like a raft waiting to float out onto the water.
Subtle variation in an iterative system illustrates how homogenous and heterogeneous qualities can exist simultaneously. The ability of 2D and 3D software to facilitate this type of production suggests a new type of tectonic development. Setting metrics, found internal and external to the iterative systems, makes possible the calibration of both adaptability and specificity. For example, an internal metric could be based on parametric modeling rules or geometric complexity whereas external metrics might be based on structural capacity or contextual limitations. The unification of this seemingly paradoxical duality is substantial for how it transforms the conventional tectonic logic and introduces a new way of design thinking.

Working out of the shadows of Semper’s depiction of architecture, techniques asserting this new type of tectonic logic attempt to reconcile the delamination of architecture as framework and enclosing membrane (Semper 1989). While Semper defines the enclosing membrane to be woven in nature and subservient to the articulation of the frame, the woven patterns of digital tectonics potentially allow for a synthesis between the framework and the membrane resulting in a structural and ornamental interdependence.

The repetition of identical structural elements traditionally provided structural integrity through redundancy. Cladding systems, while not necessarily operating with the same redundancy, have also traditionally utilized identical repetition as a critical part of the conventional tectonic logic. Homogeneity has therefore been a long-standing tenant of this type of design and building method. However, no longer being held to the dependence of identical repetition, heterogeneity is now allowed to transform the design methodology and, thus, alter the tectonic expression. Complex patterning authored in 2D and 3D software produces a structural modularity capable of being deployed at different scales, in multiple configurations, and with adjustable density and directionality. This type of flexibility allows for customization in the form of iterative transformation or a singular anomaly to have the same efficiency as identical repetition. The synthesized outcome of this type of tectonic is a structural envelope providing support while also providing a level of enclosure. The customization of the hybridized structural envelope is then based on issues like program, organizational responses, or even ornamental and aesthetic desires. These last issues are often discarded as having suspect relevance to a design process so heavily indebted to the intricacies of software or physics. However, if we are to truly unpack Semper’s definition we must shift our understanding of these terms as well. Terms like ornament and aesthetics, while conventionally relegated to the external application of a building skin, would now under the new definition of digital tectonic become an internal metric factored into the design process from the very beginning. The desired effect produced by the final architecture would be a metric of equal importance as would the metrics controlling zoning restrictions, load requirements, or contextual specificity.
Across the Surface

I am attracted to the philosopher Avrum Stroll’s book Surfaces because it offers the possibility of seeing surface as both a physical entity and an abstraction, and makes no claims about the primacy of one surface above another. It is a discussion that is played out on many levels and continuously returns to the topographic language of ordinary speech and the mathematics of geometry. Indeed the opening discussion uses ordinary things to pose extraordinary thoughts. For Example, if a dice has six contiguous surfaces without gaps or openings and it also has 12 edges, where are the edges? Can an edge be a surface? If a solid glass marble has a chip, is the chip in or on the surface? Does the chip have its own surface? These and many other everyday examples are used to pose the philosophical problem of perception through a discussion of how we define and perceive surface. Stroll then examines the geometry of ordinary speech, including words like margins, limits, boundaries and edges, to draw similarities and differences between this topological language and the mathematics of geometry. In the same breath he manages to discuss surfaces as both abstractions and physical entities. At times I find the plausibility of arguments for surface as a theoretical abstraction neatly countered by equally powerful conceptions of surface based on everyday speech in the physical world. In recent years many architects have used digital design tools to create complex non-orthogonal curvilinear forms and surfaces represented as either opaque or transparent spatial models. They reject the analytic geometry of Descartes and conventional Euclidean architectural language for one that embraces the world of the morphic, malleable and liquid. Some of these projects remain diagrammatic where surface is regarded as a two-dimensional programmatic field without thickness or bulk. Unconcerned by gravity, construction and traditional oppositional distinctions between surface and structure we might be prompted to ask what these seductively displayed surfaces are. Perhaps these experiments step outside the conventional structure/ornament debate to conceive from and surface as an ‘immaterial and pliable two-dimensional datum with no depth or internal structure’. Other digital works are committed to material and constructional experimentation in an effort to realise form and surface as a new spatial condition. More closely linked to the tradition of architecture they are concerned with the physical base of surface, and its articulation as a necessary condition for the material practice of architecture. One model regards surface as an abstraction, the other as physical.
Though they seem to be in opposition, both models have an equally sound theoretical base, and are closely allied to the two models of surface put forward by Stroll. (Taylor 2003)

Field Adaptation

Figure 6. (a) Top - Repetitive system- school of fish. 3D digital surface analysis. (b) Left & Right - Laser cut surface assembly. (c) Middle - Cut files for laser cutter - full page and detail.

To generalize, a field condition could be any formal or spatial matrix capable of uniting diverse elements while respecting the identity of each. Field configurations are loosely bound aggregates characterized by porosity and local interconnectivity. Overall shape and extent are highly fluid and less important than the internal relationships of parts, which determine the behavior of the field. Field conditions are bottom-up phenomena, defined not by overarching geometrical schemas but by intricate local connections. Interval, repetition, and seriality are key concepts. Form matters, but not so much the forms of things as the forms between things. (Allen 1999)

The exercise analyzed repetitive system behavior and took the performative aspects of that behavior through an artificial process of simulation. The underlying interest in this work was to situate current 2D & 3D digital modeling and fabrication technologies within the spectrum of thinking introduced by D’Arcy Thompson in On Growth and Form (1992). Insisting that there was a behavioral relationship between organic form and the repetition of the components making up that form, Thompson’s thinking serves as a critical component for current explorations into scripted and algorithmically generated architectures. However this exercise, rather than choosing to engage those types of digital modeling formation techniques, attempted to take up a parallel interest in translating the performative qualities of the analyzed system.

The exercise initially documented surfaces made of repetitive systems. The pictures used in this documentation cataloged a spectrum of synthetic and natural surfaces at a variety of scales. The next step evaluated the geometry of the module(s) that made up the repetitive system. By isolating the geometry of the module and the specific relationship between the modules, the first clue to performative or behavioral characteristics might emerge. The initial system was first recreated through a 2D geometry produced by drawing of a module(s) and then allowing the qualitative aspects to be recreated through certain techniques found within the software. For instance, the transformative array allowed for
iterative difference to become evident across a surface while still maintaining the initial properties of the module (Fig. 4). Following the 2D analysis, the exercise took up the same approach but through 3D modeling techniques. The qualitative aspects could be investigated through a more diverse set of software techniques. Dynamic forces (i.e. twist, ripple, fold, & explode) could be sent through the modeled repetitive system and calibrated according to intensity or scope of application (Fig. 5).

The goal of the exercise was to utilize digital modeling and fabrication technology to transform repetitive systems into responsive systems. A responsive system was understood as a repetitive system capable of customization according to internal or external forces. Thus, the customization of the responsive system was understood through two lenses that were not necessarily mutually exclusive. The first lens assured that a responsive system might be dynamic and capable of adjustment based on how the modules connection facilitated movement. This adjustment might take place in the macro effect of translating from one type of geometry in one area to another type of geometry in proximity to the first. A simple illustration would be how chain mail, using the same module and linking pattern, can transform as it covers a shoulder to an elbow, based on the flexibility of the joint between modules. The second lens reversed the relationship of the first by assuming that the responsive properties of the system came from the transformation of the module geometry. A key aspect of this lens was how the transformation of the module filtered or reflected light based on the geometry.

To this end, Erwin Haur’s architectural screens became an important foundation to understanding how minimal surface geometry and modulation could produce a variety of lighting effects. But whereas Haur’s screens utilized the same repetitive geometry, the surface’s responsive qualities were found in the changing of the geometry of the module.

The final stage was the production of a physical model that functioned as a responsive system based on the initial steps of the exercise. Although the simplest form of production would be to digitally fabricate a direct correlation of the digital model by using a 3D printer, a shift in fabrication technique required the final product to be designed in a different manner. Within the 3D digital environment the module could be designed and then arrayed. This technique was understood as a bottom-to-top logic and meant the parametric properties of the module proliferated throughout the array. However, the fabrication of the final physical model used a 2D laser cutter and required the bottom-to-top logic to be translated into a new fabrication logic of layering modules or stacking the serial section of multiple modules. By not starting with the module or conversely the final image as articulated in the digital model, a middle ground was pursued allowing the grouping or layering of geometries to become a priori. Rather than a fixation on the geometric accuracy of the digital module, the design and assembly decisions were made based on how to best recreate the effect of the original images. For instance, calibration of the thickness of material and spacing of the striation resulted in a moiré effect (Fig. 6). While this is not truly an example
of reverse engineering, it does provide an inside out approach that focuses on the translation of an original effect through a series of digital and physical operations.

The interesting outcome of this exercise was first found in the ability to recreate the effect, but more important was the discovery of those unintended outcomes. The process rendered a series of effects that were unexpected. Prioritizing the local relationships of the modules generates unexpected effects. These effects demonstrate intricate and apparently irregular qualities as a result of the combination of elements that are repetitive and regularized. By revisiting the techniques utilized in each step of the exercise, it is possible to refine the final effect. The pursuit of a digital aesthetic will inevitably emerge only out of increased tactical control over the digital design and fabrication process, but only after a shift in the organizational mode of operation takes place.

**Kid Cocoons**

Figure 7. Installation of tree house at the Dallas Arboretum, June 2006.

A **tree house** is more than a wooden platform or a box in a tree. Beyond the typical four walls, floor and ceiling, it is the adventure, the experience, and the child’s escape from an adult’s structured world. The concept of “tree house” often evokes thoughts, memories, history, and imagery of childhood and parenthood: activities and learning, the act of construction and personalization, nature and our relationship to it. But, traditional form and materials often confine the limitless imagination. By opening up these boundaries through a new way to communicate and express, we set the mind free. The form and the space itself become new sparks for the imagination.

Children’s minds can often represent the purest imagination. Unencumbered by practical thought, their ideas can push to achieve uniqueness. Elementary children at a local Montessori School provided the design team such ideas and served to strengthen our purpose for developing an alternative concept for what constituted a tree house. The children communicated their enthusiasm for spaces that provided discovery, challenge, secrecy, play, friendship, and nature. While the children could conceive that a tree house does not have to be in a tree or formed like a house, their own sketches were bound by conventional imagery.

Tree leaves provided the reference for initiating the design process. Beyond the ability to make something look like a leaf, greater importance was given to simulating how the leaf worked. Through the use of parametric 3-D modeling software, the initial surface was generated, and transformed into cocoons that create the tree house walls. This surface modeling technique was capable of responding to desired spatial qualities through a precise and calculable number of steps. The inner module was developed as the
purest form of reference to the original leaf. The outer module was a warped and stretched version of the inner module. This technique allowed the outer module to maintain a latent formal and behavioral connection to the first module. The plan for both modules was a radial array producing a standardized plan layout while also providing for the greatest amount of structural stability. By contrast, the sectional qualities were intended to be radically different and provide dynamic and contorted space that layered onto itself based on one’s position inside or outside of the tree house.

The final installation was sighted on the ground for two reasons. First, the ground location allowed greater accessibility for children, grown-ups, and those with special needs. Second, on the ground the tree house mediated the existing ground cover and the tree canopy. Intended to be something of an alien version of Bottecelli’s *La Primavera*, the modules danced around the base of the tree. When approaching the tree, the effect was intended to blur individual modules in favor of a more faceted appearance of motion.

On the inside set of modules one thousand small leaves were suspended from the inside surface. The small leaves were laser cut profiles of indigenous trees in the North Texas region. The leaves were circulated to local elementary school children in an education packet. The children were asked to decorate the leaves with narratives of their own lives. The leaves were then collected and hung as a means to inscribe personal stories into the inside of the tree house. The effect is a strange collection of polychromatic leaves that have fallen into a spider web, left to dangle freely in the wind.

The material choices were a critical component to the final effect of the tree house. Initially the cladding material was highly synthetic providing a quality of shrink-wrapped butterfly wings. However, it was eventually decided that a more organic quality was desired and appropriate given the forms and the site. Erosion control fabric was used as the final material wrapped onto the steel and PVC skeletons. The green, porous material is made of shredded recycled plastic and layered inside of two black nets. The fabric is not consistent in thickness and therefore allows varying degrees of light to penetrate through. The final result was a series of leaf pods that resembled cocoons left cracked open, no longer necessary after the caterpillar’s metamorphosis. Instead, the discarded cocoons have become a playground for the children to project their own interpretation of discovery, secrecy, play and nature onto.

**Cultural Lexicon**

![Figure 8](image_url)

(a) Andrea Mantegna. Fresco on ceiling at Palazzo Ducale. 1473. (b) Abbey Church of St. Denis, ribbed vault of ambulatory ca. 1140-1144. (c) Conventional suspended ceiling system.
The complex and ambitious Italian tradition of illusionistic painting applied the Renaissance confidence in handling perspective to projects for ceilings and overcame the problems of applying linear perspective to the concave surfaces of domes in order to dissolve the architecture and create illusions of limitless space. http://en.wikipedia.org/wiki/Baroque_illusionistic_painting (Accessed May 7th, 2006).

The ceiling provides an interesting reflection of cultural identity over the course of architectural history. Serving as a cultural lexicon, the ceiling reveals the intricacies of a society’s organizational framework. From the nascent and rudimentary beginnings of the cave to the grand and culturally prevalent cathedral narratives, the ceiling became a surface onto which humanity projected idiosyncratic stories, societal preoccupations, and even subconscious habits.

In the hands of the Italian painter Andrea Mantegna the ceiling became a canopy on which he worked out bold and daring perspectival stories that defied the very surface on to which he painted. Both as an act of technique and geometric mastery, he was able to transform the thin surface of paint applied to the ceiling and extend a portal into the heavens. This illusionistic style provided a momentary transcendence for the cathedral visitor and told stories to those who were willing to look and listen. The ceiling was a repository for cultural heritage and spiritual connection. The ceiling, in this context, played a different role than the traditional wall fresco. Whereas both provided a narrative voice, the ceiling fresco negotiated and even transformed the geometric space onto which it was painted.

The six principal arches of the vault were generally more heavily built than the intervening spaces, and so the term rib vault is typically applied to these vaults. Looking upwards at a rib vault, one sees these six ribs serving as the ‘skeleton’ of the vault. This standard type of vault is called a quadripartite rib vault; with a slight variation, it became a Sexpartite rib vault, which is divided by eight ribs into six parts.” http://en.wikipedia.org/wiki/Rib_vault (Accessed May 7th, 2006).

The ceiling in Romanesque and gothic cathedrals became an overt expression of structural ingenuity. The ribbed and groin vault resolved the structural demands of a multi-directional axis that the program demanded and, at the same time, provided ornament to the surface of the ceiling. This blurring of structure and ornament advanced the stereotomic construction method so that each customized masonry unit became a unique vestige of the building system.

In the hands of some master architects during these periods the ribbed and groin vault, followed later by the fan and net vault, became a delicate line work that effortlessly danced from column to column supporting a parade of complex geometric surfaces throughout the cathedral space. The rib served as both an exoskeleton and an organizational map for the space below. Height and vaulting intricacy typically indicated more public or prominent programmatic zones. The dialog between the construction technique and the visitor was perhaps subtle, but critical to the
design aspirations of the space.

In construction and architecture, a dropped ceiling, also referred to as a drop or suspended ceiling, is used as a secondary ceiling formed to conceal piping, wiring, or ductwork, into an area called the plenum. Consisting of a grid-work of metal channels in the shape of an upside-down “T”, suspended on wires from the overhead structure. These channels snap together in a regularly spaced pattern—typically a 2x2 or 2x4 foot grid—and each cell is filled with lightweight “acoustic ceiling tiles” or “panels” which simply drop into the grid. Tiles can be selected with a variety of surface textures, and are typically white, but can be painted any color using standard latex paint. Fluorescent light fixtures of the same dimension, and incandescent lights are then installed into the grid, as desired.”


While the cathedral ceilings of the past 500 years have provided inspiration and archived the ingenuity of artist, designers, and builders, the modern suspended ceiling offers a very different story. Owing much to the spirit of modernism, the suspended or dropped ceiling exemplifies the unadorned repetitive efficiency of a homogenous system. Found in almost every building typology today, these blankets are almost a forgone conclusion in defining an interface between mechanical spaces and programmed spaces. As a model of efficiency and flexibility, it is hard to argue against the necessary role that this type of system plays in a world now so driven by economic viability. In providing a neutral matrix, building systems like lighting, HVAC, fire suppression, and even audio, can plug into the suspended ceiling with ease.

It would seem possible to suggest that the suspended ceiling expresses as much of a cultural identity as the previous examples of frescoed ceilings and ribbed vaults. The aspects of standardization that have long defined a global fixation on mass production seem to be clearly evident in a system like the suspended ceiling. The heritage of the industrial revolution suggests this type of system personifies a cultural ethos prevalent for the past 100 years. But unlike the previous examples, or even other architectural elements of the modern architectural era, this example is easily discarded. In fact, the suspended ceiling is implemented because it is a disposable system. While this represents some aspects of global identity, it has probably been the most evident in the building practices of the United States.

The post-industrial revolution now requires a different response. Mass customization, renewable and reusable material sources, and post-modern cultural theory all necessitate a different response to the way the architectural world is defined. The ceiling is one layer of this world, and one that for the past 500 years has played an important role in reflecting back the intrinsic identity of an era. To that end, a shift is underway. The ceiling, especially the suspended ceiling, is a territory worth revisiting and challenging. Ultimately the transformation of this system, like so many other design and building systems, will grow to reflect the ethos of the current era. It would seem inescapable that digital fabrication will play a role in this evolution.
The Gossamer Veil

Students were asked to examine this building convention and look at ways digital fabrication might alter the existing fabrication process and final outcome of such a system. The research and conceptual directives established for the project attempted to erase current modernist ideology of homogenous repetition and, instead, privileged an associative architecture. Working with a limited number of geometrical ‘parents’ and a fixed set of parametric controls, it was possible to customize the complexity within a spectrum of potential outcomes. Simply stated, a few select pieces produced many different outcomes all of which were capable of: 1) erasing the hierarchical presence of a privileged framework and 2) respond to a variety of design considerations and/or forces.

An adaptive system was sutured onto the existing dropped ceiling and latent programmatic relationships could thus become more overtly crystallized. In effect this step exaggerated the inherent flexibility already found in the suspended ceiling. Three modules were developed to handle an array of possible configurations: bevel, turn, and standard. Within a 3D modeling environment these modules were then applied to a series of hypothetical programs inside different scaled spaces.

The modules were treated as micro topographies containing different levels of disturbance. Thermo forming over a CNC milled formwork was determined to be the most suitable fabrication technique. The mass production capabilities of thermo forming ensured both precision and standardization. However, with slight variations to the 3D model and formwork it was possible to produce a variety of

In an associative architecture, design procedures rely on a limited number of geometrical and numerical parents that can be easily modified and then regenerate the whole design of the building as well as its manufacturing programs. (Cache 2003)

How can digital fabrication techniques be leveraged against conventional building practices?

The suspended ceiling is a building system found in almost every architectural typology in existence today. This universally applied veneer admittedly conceals the internal organs of a building and provides a hyper generic matrix through which lights, HVAC, and fire suppression can be organized. But can we ask more of such a system? Can we ask for a greater degree of expression, specificity, and even programmatic correlation from something so banal?
outcomes with very little adjustment to the process. As well, the thermo formed modules were made out of thin acrylic sheets with compound curvature and provided a lightweight, structurally sound result.

The modules were also made from a clear acrylic. This provided a transparency into the systems that were conventionally hidden by the suspended ceiling system. It was decided that straight transparency was not as desirable as a masked transparency. A crystalline surface comprised on 1’’ facets over all the modules was introduced to the scripting path of the CNC production. This produced a veil-like topography that rippled through the space and caused light to take on various qualities as a result of the configuration of the modules, the form of the individual modules, and the facet detail applied uniformly across the entire installation.

Conclusion: Synthetic Waves of Change

The difference between the mechanical and the machinic is precisely aesthetics. The machinic implies a creative becoming that is a fusion of the expressive and the mechanical sensibilities. (Lynn 2004)

As the methodologies of digital investigation find both broader application as well as more sophisticated implementation, it is evident that the performative characteristics have emerged as a critical aspect of the digital design process. These excerpts of partial architecture attempt to illuminate the relationship of repetitive geometry patterns, organizational complexity, and the resulting effect. It is implied that inherent to this work are biological examples. These examples, like the ethereal topographies of the clouds or the cocoons of a butterfly in waiting, suggest an articulation that have until now been explored primarily through an applied narrative. However, it is now possible to implement the computational sophistication of digital modeling methods to the tactile and physical production of surfaces. The body mediates between the
natural and synthetic systems and remains the most innate method by which we comprehend the simultaneous qualitative and quantitative properties of these biological systems.

The digital fabrication tools now being utilized in professional and academic environments today introduce a new avenue by which we can investigate notions of beauty, ornament, and aesthetics. No longer applied, nor subjectively teased out, these terms are now primary factors of influence and control introduced at the initial stages of the design process. Surely the collaborative force of these new tools will initiate a broader discussion of relevance and intention for these types of factors. The partial and unformed architectures of the moment would seem a necessary testing ground for such explorations.

References


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