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Projects exhibited designed by Christopher Peli under the guidance of architecture professors Branko Kolarevic, Andrew Seager and landscape architecture professor Les Smith at the Ball State University College of Architecture and Planning during the autumn semester of 2005 and architecture professor Kevin Klinger at the Virginia B. Ball Center for Creative Inquiry along with the participating students of the seminar during the spring semester of 2006.

All photographs, diagrams, renderings and text by Christopher Peli, unless otherwise indicated.
Enmeshing Ecologies
Digital media augmenting critical analysis
Form generation from dynamic natural phenomena
Re-examination of site from layered complexities

In the coming text, several integral concepts will be explored through the revealing and relayering of our conceptions about nature and humanity. It should be said, that the title of this paper, Enmeshing Ecologies, does not merely hint at the possibility of our human world existing intertwined with the natural, but states that these are inseparable forces acting upon one another, enmeshing their effects across all involved systems.

Once more, examination of our cultural practices in the face of this view shift must begin to take responsibility for its own survival and the survival of future life on this planet. We must engage in the fusion of our existence with the cosmos through incorporeal bodies of art, by engaging our senses, and see the art of architecture as the interface where engagements of the real are allowed to permeate.
Natural Energies

As a stream of automobiles passes along the assembly line, with a final polish for the new car lots, a television displays colored dots representing it. The image of the automobile is sliding ruthlessly through thin sheets of water with a professional driver at the helm. The car is red. Its newly applied wax coat shines in an artificial sunlight and the grill reflects a sparkle as if it were brushed with Crest toothpaste. The impacts of this high-technology on our culture do not seek to nurture the world in which it exists. The motivation of high-technology at the present is one of efficient, inexpensive distractions. What do the machines of our age draw from? What are the design parameters that dictate how we live in this world? We must seek to reveal the real story, the actual impacts of our image-based culture and root out the detrimental affects we impose on ourselves and our environments.

Why is a connection to our environments necessary? First, it will become crucial to examine the usage of the term environment. Wilderness areas are the subjects of the natural, evolving and indigenous biota. In an urban context, the environment is composed from the unnatural, the synthetic and the non-indigenous. However, we still find traces of the natural biota win the dark corners of subway terminals, sidewalk cracks underfoot, and flushed along the hard surfaces of our architecture. The urban synthetic is merely a layer of the environment over the existing, unchangeable biota that once existed, that has now morphed to fit within its new context. The difference between the urban and the wild is not the polarity of the natural-ness found in the material life residing their, but in the interconnectivity between those subjects. The fit of the urban layer within the context of the biotic is dependant on its ability to interplay with the uncontrollable dynamics of nature.

Therefore, within the human systems we design and use, if we are to speak universally of environments, we must establish between what it means to have an environment, simply mean-

ing the context that surrounds, or becoming environmental, or having a dynamic relationship with those surroundings.

A model for examining natural places involves a layering of conditional influences. The geological, the hydrological, the biological, the meteorological, break the complexity of the wilderness into frameworks, or spheres of influence, that shape the total system. If then, we are to think of human systems as an overlaying anthropological sphere which does not supersede, nor disconnect from the other systems, but morphs the landscape in fit and unfit ways. “Today we know that neither nature nor cities are in harmony, that is, in a static state of equilibrium,” states Manuel De Landa. “Both natural and social structures emerge in a complex dynamic process, which may involve changes from one stable state to another, from one steady stable state to a cyclic stable state, to a more chaotic stable state. Cities are unstable eco-systems far from equilibrium.” That is to say, as sterile as we may perceive our lifestyles, the effects of our chemicals, products, foods, medicines, transportations, “advanced technology”, we will never be able to escape the repercussions of our layer’s stimuli on the context surrounding us, for good or ill.

Why then must we continue to act in manners that perpetuate our own demise?

Ecological misinterpretations

It is often that a child is misled to believe that food comes from a grocery store, since without any other point of reference, it seems entirely logical that, when you are hungry, you go to a store, and there you will find sustenance. However false this reality may be, it is observable that disconnect between the process of food production and food consumption is carefully hidden from the eye of the careless or ill informed.

The grocery is only one slice of a massive technological and information disconnect which is continually manipulated. Much of what the United States will consume in the next decade will
result from the increasing global market, which carefully hides the places in which products are made beyond the border of the country, where the disconnect reaches its ultimate severance. Because our culture no longer produces its own goods, it has experienced a slow degradation in its ability and craft. Instant foods have replaced culinary knowledge; machine made replaces the hand made. So called “advanced” tools are making knowledge and craft irrelevant. As long as the perceived price of the good outweighs the labor, our culture will continue to purchase its life rather than creating it.

In order to craft, a detailed knowledge of environment must be present. The carpenter must know the tree and have a conversation with for beauty to materialize. The farmer must possess a higher state of awareness of climate, soil types, and water patterns in order to plan the farm, the crop and the harvest. The livelihood of his or her existence depends upon it, just as the flocks returning north in the spring must know that a hasty migration will surely lead to their demise. An environmental synthesis is critical to survival of all things, regardless of its technology state.

In order to craft, a detailed knowledge of the tool must be present. An ever increasing bombardment of new gadgetry pervades our culture but receives little in criticism of need. Where once we possessed a tool with several, ambiguous but un-prescribed uses imbedded within it, now the tool has been divided into “specialized” but quite one-dimensional products. Most notably, kitchen utensils become the subject of massive single-purpose tooling. With an emphasis on quickness and ease, these products (as seen on TV) reduce our ability to invent. Furthermore, it defines our need for new technology by reason of simplicity, using it as a crutch for accomplishing more in less time. Rather, we should critically explore the tools we are given to find the maximum potential for positive change in systems, not merely reproducing old methods quicker (and of lesser quality).

The cultural perception of a return to natural harmony is one of human retrograde. Contemporary societies may in-fact fear nature and see a return to it as a digression, losing the essence of our culture by giving up our status quo, our comfort. The principals by which we consti-

tute an ecological shift are not to be based on a purely Luddite model of technological surrender. As Amerigo Marras states in the book ECO-TEC, “We are searching for a far more complex involvement of communities and specialists in a context of informational wealth, not necessarily a simple return to nature.”

In actuality, natural harmony is give and take. Native Americans realized that in order to maintain ecosystem stability, humankind cannot only extract from nature what it needs, but also give back to nature that which it needs from us. It is not that this culture did not manipulate and alter the landscape. The underappreciated sophistication of these people which permeates modern American history leads one to believe native cultures as nomadic savages with little to no cultural impact upon the landscape. In fact, we now realize that early native cultures of the Americas made extensive alterations to the land where they resided. These findings only heighten our respect for a culture who managed to sustain massive populations of people with considerably minute negative impacts. It was because of this that their cultural impact left only beneficial and sustainable effects on the landscape.

A common mantra for the National Parks Service suggests “Take only pictures, leave only footprints.” This is precisely the impact-reductionism that convinces us the potential for our human culture and human artifacts as destructive only. It uniformly assumes human impact as negative impact due to our massive lack of consciousness and disconnect. What if we were to reverse our negativity and alter our preconceptions of human and nature into human in nature? We might instead say, “Leave positive effects, then take photographs”.

Think of the symbiotic relationship between plant and animal. The animal breathes in the oxygen produces through photosynthesis, while the plant requires the carbon we exhalate. Wetlands filter our wastes from the water and use the minerals to re-supply the food chain. The tree in the forest not only extracts nutrients from its surroundings, but provides habitat for the ecosystems it exists within. We have removed ourselves from the systems we once were part of, and as a result, no longer supply nature with that which it needs to sustain. Growth need not
come at the cost of another’s reduction. Our manifestations and manipulations must capture a relationship with nature through intelligence, and symbiosis.

Our culture need not dramatize the ecological principles of green building or a green lifestyle as something absurd or unordinary, but soon it will be come as commonplace to life as handicap accessibility, something which did not exist in our social understanding until the 1970s. It need not be the foremost attention of a structure, but will weave itself into the fabric of design by our sensitivities. Whether minimums of energy production manifest new thinking on low energy places and devices is of little consequence, as we move into a new realm which focuses on the productivity of a person or group based on their psyche and comfort. As we learned at the height of modernism, environments which sever all relationship to the outside are not only disorient in bleak uninteresting form, but also quite unhealthy both physically and psychologically. We learn that it is not the basis of the form which contributes the most to the welfare of an occupant, but its connectivity to the outside world which gives us delight.

The real recognition here is breaking down the concepts of civilization and ecology as two separate and opposing ends of a spectrum. It is precisely this view which enables us to forget our ecological impact by distractions of technology. If we move towards a rapidly consuming technological based society, through the delusion that science will save us, then we have set up our failure through ignorance. Science, that is, knowledge and information enabled by the hands and minds of a few elite, will never satisfy but only capitalize on an uninformed society’s demand for consumption. (Here, we should not recognize the term science as an ultimate, as put forth by this generalization, but term our inquisition as sciences, just as there exists no art, only multiple arts of investigation.) If we move the information of science, that is, the critical analysis of causality in our universe, into the minds of an informed social structure, then a rapid change in the demand paradigm will allow the consumers to demand proper and just
leadership from designers. In other words, an informed culture will demand from the designers of our society that will promote the health and welfare of all beings in the local and global ecology.

Placing our human social environment and our ecological environment as co-existent and informing overlapping layers allows humans as designers to account for a far broader range of effects possible through our art. Take for example, a natural occurrence such as a river. Before any human development, this river was the central form for every organism in the watershed. The geology and soils, flora and fauna are all indexed by the flow of the water into this basin. Meaning, any event taking place within a given flow of water, eventually will find its way into the river, and as such, the river can be "read" for certain occurrences on the land which it represents.

Our human culture is no different. Earliest settlers of the land used river flows for sustaining life, through nourishment, transportation, and energy. The forms of the natural informed the form of the human built. Cities emerge from the landforms created and "possessed" by natural features, and no matter how we attempt to overpower these forces our built form will continually fail to provide a lasting engagement with the natural forces.

It is for these reasons that there must be a shift in our perception of built form within the context of nature, one that does not attempt to overcome and dominate, but to harmonize, formally and contextually with natural flows. Our human fabrication can no longer sever our cultural system from the natural system, but should serve as an interface between these. The current prohibitive architecture which demands that the natural flows be seen from a distance or from the outside looking in will not suffice. For a cultural ecology to exist, full comprehensive understanding must involve an interactive process. The effect of ecological understanding in our art is not limiting, but rather limitless, as the constant exchange of dynamic forces will allow an unprecedented number of beneficial evolutions in our environs.
Emergent form
Emergence from ecological connection and the intuitive rational

...there is lacuna in the theoretical body of architecture, an absence that is marked by the proliferation of design processes that borrow the appearance of scientific methods yet lack their clarity of purpose, mathematical instruments and theoretical integrity.

- Michael Weinstock

Blob. A term coined by Greg Lynn in his book *Folds, Bodies and Blobs*, a trend in architecture to rationalize the use of non-standard curve forms in space making, while intriguing aesthetically, serves modest alternative purposes but experimentation in synthesis of sculpture and building. While new form finding techniques of design question our use of the strictly planar as a means of spatial arrangement, trumpeting as Lynn deems "mastery of a [digital] system to the point that it becomes transparent", it in no way questions our continual use of inharmonious forms and materials of any kind. In short, if parametric design is the mere assemblage of an array, by which form emerges to balance the complexity of input generators, the initiator or collective of designers must tune their sensitivities towards a total understanding of ecology.

What good is a blob if its form is entirely derived void of a realistic context? Architecture deals in the relations of function and space as it relates to the needs of the land and humanity. Without this context, blob-form is merely sculpture, falling victim to the same temporary decompositions of pop culture. Have our structures become only the passing phase of a mere style, generated alone by the precedents of those infatuated by blobs? What context for a sculptural form is the rigid orthogonal urban landscape? Assuming fluid forms could be the product of parameters dictated in a landscape, more complex formal relations will result from complex environments, such as those found in natural ecosystems. The form will wear its histories of environmental impact and calibrate it unwittingly. Just as the river carves a canyon,
revealing historical slices, each layer of earth revealed modifies the river shape and vice versa, to create histories or versions of the river form. Stratifications of soil will affect the waters with unique minerals, altering the pH levels, water cycles and subsequently the flora and fauna of the ecosystem.

Materialism and physical formation naturally leads to the discussion of surface and surface effect in the realm of digital form-making. An ever growing infatuation with predominantly plastic digital surface form attempts to break from traditions of structuralism and component revealing in architectural tectonics. Just as the digital model exists without seam, without mortise and without adhesive, so too do the designers of these forms attempt to create in live constructs. Siting biological organisms as precedent for such aesthetic, the effect is void of any actual biological effect, only drawing from the sensual quality of its form and neglecting the substance of biological systems. So called phenotypic designs, drawing from environmental parameters to generate formal responsiveness have so far only managed to quote natural orders in a hollow and dangerously misrepresentative manner. In a section titled Arbitrary factors to create the total composition, ABB Architekten explains form-finding in the Dynaform-BMW Pavilion.

We operate like a composition of John Cage. Arbitrary and fanciful factors create the total composition. This method is anything but exact, but also not completely random. Rather than design, we control, as the designer, a process. The form is "somewhere out there" and is waiting for us to realize it. By means of a computer, we provide the form an opportunity to manifest itself. This is how we create "communicative" architecture with the aid of the computers.

In addition to an egregious representation of the artistry of John Cage, Dynaform advocates drawing from arbitrary generative formation methods to derive a construct vacant of actual relationships yet described here as "communicative". Here, I question the nature of so called communication between context and form relationship. A communication is described as a relation of exchange. What is being exchanged? What is the form relaying to the context and how does it impart a positive responsiveness towards its surroundings? Janine Benyus, author
of Biomimicry: Innovation Inspired by Nature presents a different precedent for formal variances based on context criteria.

Sun leaves on some trees have adapted to dissipate more heat by being smaller, thicker, and more deeply lobed. This makes the surface of a sun leaf a shorter distance from a free edge; and, since the boundary layer thickness increases with distance from an edge, it will have a thinner boundary layer of heated air.

A direct response to a literal environmental factor, the form and material of the system find balance between a need for sunlight as a photosynthesizing agent and a requirement that the leaves not overheat from this exposure. Are generative formation methods really providing “the form opportunity to manifest itself”, or is this merely an expression of post-rationalization? Methinks the latter.

However materiality is physically manifested from the aesthetics of this new architectural process is of course reliant on the personal intentions of the designer, and is necessarily attempting to break from ancestry via non-materiality. That is to say, plastic form is derivative of plastic form-making and therefore the plasticity of space and the non-sensual non-materiality of this form rebels against the existing pretenses of architectural standards, just as an adolescent seeks to break from the structure of its parent by blind disobedience regardless of the parental teachings. Ali Rahim explains in his essay Designing and Manufacturing Performatve Architecture:

Experimental architects are able to take advantage of this shift from material reality to potential probabilities. Emergent animations are reliant on the computational logic of high-end software to achieve this unpredictability by moving away from deterministic, material quantities to relative qualitative potentialities.

Indeed, neo-formalism architecture seeks to distance itself from the traditional practice as a means of self-referential radicalism. But what is gained from the experimentations in form making by suspending materialism is lost as these avant-garde proposals seek to materialize outside of the digital realm. If we are to create such spaces by computational logic, what precludes
these spaces from exiting this logic is precisely that it is not rooted in a reality; not rooted in the earth, but floats above it, transcendent and hypothetical.

As of late, the trend in surface treatment of complex urban situations paints the façade with what Lynn refers to as “media skin” to create interactive environs with users. Evident in Lynn’s Eyebeam Atelier Museum and dECOi’s Aegis Hypnosurface among a growing list, are using digital surfaces as a spectacle of light display. These surfaces effects boast interactivity for their high-tech usage of advanced media, essentially becoming elaborate telescreens. Cultural infatuations with media streams have driven designers to now implant users within a disorienting super-televisual-environment where interactivity with the architecture is explicitly prescribed. In all, attempts to create interactive spaces are merely using architecture as a projection base for more media-bombardment.

Can televisional space even boast interactivity, when the flow of interaction has specific, one-sided consequences that are never allowed to adapt? While super-technological innovations today may seem to evoke dynamic human spatial interaction, it seems that they will quickly become obsolete in the near future for their inability to adapt those interactions. Can generative forms harbor surfaces for biological interactivity that create a mutually positive relationship with users, rather than projecting false imagery onto them? What of a space that harbors olfactory spaces created using flowering plants which offer the opportunity to clean the air and water of the environment? This generative space would become the framework for ecological understanding, as human users would understand their place in the biological cycles, as the air they breathe is cleaned by plant life, the water that comprises them is filtered by the biome.

We may dub this the “re-forestation of architecture” for as we deal with morphing surfaces in space and form, we should also begin to shape every surface as component of a larger biological whole. Where green architecture promotes green roofs and digital space making blends our
concepts of what constitutes a roof, like a lush rainforest, every surface and every structure within the system is a canvas for beneficial life to emerge.

Human intervention in undisturbed wild areas has become devastating and the impact has seen no improvement. Naturally thriving ecosystems remain very much a mystery in that the depth of subtle implications and causalities can lead to destructive effects. Handling these complex parameters of life within a given ecology can become the design parameters by which an installation into the realm can co-exist, and even improve the quality of life existing there.

What must become extinct is the concept of a greenhouse, or at least the precedent set by 19th century architect Joseph Paxton in the Crystal Palace, a separate and distinct box offset from context and romanticized through "disappearing architecture". The capabilities for natural substance to enrich our well being have been greatly diminished by the progression of highly processed and source-cloaking materials. For example, the Monterey Bay Aquarium, California (by EHDD), does not boast aquatic species from around the globe, as most zoological museums do. Instead, the aquarium is simultaneously a research lab and educational facility that is entirely focused on the local species of the bay and near shore ocean organisms. Here, the architecture frames a locally beneficial institution and also speaks to the place in ways that cannot be conveyed without a snorkel.

What of an architecture which produces local effects that are both educational and biologically beneficial, rather than imparted and disjointed from context?

Dynamic model precedents:

...it is no longer a question of imposing a form upon a matter but of elaborating an increasingly rich material... What makes material increasingly rich is the same as what holds heterogeneities together without their ceasing to be heterogeneous.

- Gilles Deleuze & Felix Guattari

Architects commonly phrase their design intentions as achieving optimal harmony within the composition of the surrounding landscape and public spaces. Our built formations are judged therefore on their ability to synthesize and weave into and existing fabric of conditional impacts. While noble attempts to harmonize our environments and our built edifice, we do not distinguish between landscapes that are in balance and landscapes out of balance. Meaning, designs seeking to harmonize with surroundings merely succumb to the dominant, cacophonous systems already existing in our expanding urban landscape. What good would a harmony do to improve the face of our planet if it is only harmonious with that which is set to over-run it?

Formations in natural design ecologies

Lines of thought regarding the synthesis of our understanding of landscapes and the creation of our forms are traced through precedents across a diverse field of inquiry. Most notable to those interested in digital formalism is D’Arcy Thompson, the early 20th century zoologist and mathematician. Thompson’s analysis of warped patterns in living things led him to surmise that “Form is a diagram of forces”. This quote plants the seed for several consequential movements in phenotypic observation and design. First, that form may find a situational balance within its environment. Second, invisible guiding forces of nature are made apparent and concrete, and thirdly, that these forces and circumstances of the world are not only observable, but calculable by diagram. Where once nature was a random series of instances encoded in genotypic coding, it is now possible to work from the outside inward and reveal the dynamic systems of form.

D’Arcy Thompson’s work, however, recently set forth a series of rigorous, rational and math-
emathetical based design methods in digital architecture, which still bases its understanding of contextual relationships as a set of codes and formulas. We have still not explored the possibility of intuitive reasoning to generate form and furthermore, we are not limited in our observations of form in nature to living creatures, which are still thought to have components of "code" and therefore become mathematic generated. If a diagram of forces is applicable to all material forms, then we must understand too, those which possess no genes whatsoever.

The diagram now is the critical document of design, and its formation is based upon rules of understanding which appear as intuitive progressions of interrogation. Renowned landscape architect Ian McHarg developed a very simple practice of overlaying layers to ask the site for design guidance. Here the methodology is not derived from computational skills, but by critically considering the representation of overlapping relationships between elements of a landscape. McHarg pioneered the technique in his 1967 book Design with Nature by gradating a landscape according to specific rules, such as slope, soil type, hydrology, vegetation, etc. Using a system of gray-shading based on suitability of various design elements, he allowed the site to dictate placement of form and the form emerges from the process of investigation. Quite simply, the diagram of forces is inextricably linked to the form, yet possesses no coding from internal information.

The persistence of mathematics in design forming must not be allowed to dictate the trajectory of outcomes alone. However, digital design is inextricably linked to the properties of rational computation. Therefore, it is imperative that the data and information recovered from site analysis be transferred into form in order to convey the spatial properties it represents. McHarg’s diagrams do precisely this, giving both raw data and spatial relationships in the same interface.

Lynne Hull, a self-proclaimed “interspecies-artist”, expands the potentials of design beyond anthropocentrism. Potentially the most important aspect of ecological design is our recognition of non-human forces beyond our capacity for control, and that we must acknowledge and exemplify these events in order to draw a cultural concern to our global footprint. Archi-
tecturally, we can draw from Hull’s manner of collaboration with the animal (framework or instance giving a suitable and exploitable position for it on the landscape) while maintaining and improving the landscape around it. Forms derive from site characteristics, modeled and created for use and adaptation by organic systems and employ the use of non-standard digital fabrications. These instances would provide benefit to wild ecology without a prescriptive use or framework for need other than siting a specific ecological problem. The National and State Parks Services, just as the landscape design of trails, boardwalks and human services currently, would employ practice as means of restoration and sustainability. However, the goal of these wild installations would aim to integrate fully into the ecology of the place. Certain attention must be focused on authenticity of the landscape, to avoid the popular Disney-fication of natural places for the sole purpose of viewer attraction and boasted park attendance. These forms must act submissively and even invisibly in the landscape, the goal or purpose to provide health and welfare, not fame and attraction.

The 1991 installation by Buster Simpson, entitled Hudson River Purge, draws direct parallels between the crisis of human health and the crisis of environmental health. Here, soft chalk limestone disks measuring 24” in diameter and 3” thick represent metaphorically and pharmaceutically antacid tablets, which inherent in the nature of the limestone’s chemical make-up, balance the acidic levels of the river due to runoff and direct dumping pollutions. The alkaline properties of the stone balance the pH of the river at the headwaters of the Hudson, which is part of the New York City water supply. Simpson introduces a material quality that is often neglected in material design decisions, the direct biological effects of matter on a microscopic scale, and rather than use of materials which attempt to reduce the harmful effects, encourages health and welfare of the site. Since the site of river is not constrained to the immediate surroundings, but impacts every ecosystem downstream, it encourages us to think of all sites as being upstream in a chain of interconnected ecologies.

Similar to the work of Hull, Simpson encourages our inter-reactive involvement with the world around us, the world which becomes us,
by introducing new players and therefore new parameters to design decisions (erosion control, deforestation, water pH levels, bacteria population control, etc.). If we can begin seeking out potential problems and recognizing potentially beneficial outcomes in our constructions on the land, simulating outcomes as positive impact generators rather than negative impact reducers, the richness of the design will evolve out of the collaboration with natural co-existing systems and is made apparent to the human participants of the architecture.

Formations in digital design modeling

_Complexities of existing formal relationships in local environments navigate through site specific design & mass customization_

In the works of Greg Lynn and Bernhard Frank, the form generation arose out of an abstraction of "perceived" influences in the landscape, which became modified by the individual intents of the designer. Hence, the form becomes nothing more than exotic shapes without actual contextual meaning, insignificant except for the feat of its construction. In a sense, the ends justify the means. That is to say, advanced fabrication technologies have introduced a seemingly endless variety of formal, material and systemic possibilities in architecture, therefore, the profession should become compelled towards this freedom of constraints as well.

What good is a blob if its form is entirely derived void of a context? Architecture deals in the relations of function and space as it relates to the needs of the land and humanity. Without this context, blob-form is merely sculpture, falling victim to the same temporary decompositions of pop culture. Have our structures become only the passing phase of a mere style, generated alone by the precedents of those infatuated by blobs? What context for a sculptural form is the rigid orthogonal urban landscape? Assuming fluid forms could be the product of parameters dictated in a landscape, more complex formal relations will result from complex environments, such as those found in natural ecosystems. The
form will wear its histories of environmental impact and calibrate it unwittingly. Just as the river carves a canyon, revealing historical slices, each layer of earth revealed modifies the river shape and vice versa, to create histories or versions of the river form. Stratifications of soil will affect the waters with unique minerals, altering the pH levels, water cycles and subsequently the flora and fauna of the ecosystem.

Human intervention in undisturbed wild areas has become devastating and the impact has seen no improvement. Naturally thriving ecosystems remain very much a mystery in that the depth of subtle implications and causalities can lead to devastating effects. Handling these complex parameters of life within a given ecology can become the design parameters by which an installation into the realm can co-exist, and even improve the quality of live existing there.

An example of actual environmental relationships reflected in architectural form comes from the offices of SYSTEARCHitects, where a small vacation home in Australia is allowed morph according to weather, program and activity. The Located in a flood plain, the parishHOUSE is stilted and responds structurally with a light materiality comprised of a continuous skin surface supported by thin ribs of 50 millimeter plywood which weave laterally to provide more rigidity with less structural section. The project must be complimented for its use of digital design in section without merely creating flat sectioned ribs. The continuous exterior envelop has gaps, slits and misalignments that allow light and air to circulate through the house. The resulting slits and gaps are proportioned to the geometries demanded of environmental influx. All components are digitally defined and milled with CNC technology.

In the case of the Great Court of the British Museum, Foster and Partners were forced to deal with the complexities of the existing form museum to achieve the enclosure. By fitting a geometric torus form to a rectangular boundary, a self supporting surface was created with significantly less material usage. The desired lightness of the structure was achieved with thin steel frames, triangulated and glazed. The triangulated frame was attached with similarly shaped, but uniquely measured steel connector plates, each CNC fabricated and labeled.
Here the complexity arises from the intersection of geometry and material, and the logic of the system is dependant upon mass production of custom shapes, individual but related. While Foster and Partners' distinctly sleek and highly processed style evokes no sense of ecological concern, it does however frame the sky in the courtyard as the defining element of the space and pays respect to it in the face of its urban context.

This is typical of the firm's work, as exemplified in the Swiss Re Tower in London, where the form is derived from calculating a highly efficient surface which reduces wind-loading by aerodynamic modeling and creates natural ventilation through interwoven air chambers which pull building heat up through the exterior skin. The complexity of the architectural form is directly calculated with the aide of computational simulators within the digital building model. Computational fluid dynamic simulations allow spatial design to evolve quickly and towards maximum efficiencies through form manipulations in near-real-time. The growing interest in simulation building testing exemplifies the concerns we as designers have for the environmental issues informing architecture.

But as Chris Wise indicates, "...the key to the success of the whole caboodle is the human mind which...filters, edits, composes, interrogates and challenges. So I would like to advocate less algorithms, more responsiveness, less technological drunkenness and more direction. Less silicone-chippy, and more brain." To be sure, critical examination of these highly powerful tools must acknowledge the "technological drunkenness" and bring to it a concern for what we observe as a socio-environmental technology infatuation crisis. Meaning, the most potent use of our digital tools will come from our ability to synthesize it into design concepts that are not derived from the exploitation of new technology alone.

Wise continues, "So far, the emergent technology has usually had to limit the output of the process to an object rather than a project. A project has a definite purpose. A project has a site. A project interacts with people. It interacts with climate. It interacts with time. And unlike a computer process it is made of imperfect materials and things that change according
to this interaction. In short, the project lives. And in part, in having a life, it enriches the lives of those involved in putting together the project and the next one. Somehow the algorithm and the wax modeler don’t quite do this for me. Yet."

These examples work the urban aesthetic into an energy and resource consciousness, or rather global resource responsibility into the urban fabric. But we may ask how does this sensibility adapt outside of the urban realm? How would it adapt to a composition of “imperfect materials”? What would a digital design be within the context of unfettered nature?

Designing methodologies:
*Digital media augmenting critical analysis, form generation from dynamic natural phenomena and the re-examination of site based on these new principles for understanding complexities.*

Complex handling of varied design parameters within architectural thinking is enabled by digital design media. By layering information in digital space, we can create a better understanding of relationships between seen and unseen forces of the environment. Given the higher complex handling of our computational means, the methods by which design generates must modify to refocus on previously unapparent and incalculable natural occurrences. Often described as “form-finding,” as opposed to form-making, we recognize the flaws in thinking of design as product, and the perceived permanence of these objects in the landscape. Instead, process fuels the outcomes of form, and our methods for understanding and distilling information emerge as the critical component of design.

Let us, for instance, diagram this concept of layered influence as McHarg might picture it, a plan diagram using color coded ranges where variables in the landscape exhibit particular qualities. Here, the layers are simplified to the orders of geology, hydrology, biology, anthropology and meteorology. Now given the number of variables in a specified landscape, let us assume that rather than one variable occupying a space on the map, that all of these variables
exhibit more or less of its characteristics in any specified point on the surface. Therefore, a two dimensional map is no longer sufficient for organizing our information. Our data reads more like a series of interwoven layers, and if we were to take a section through this model, it would look something like a line graph depicting the information about that particular stripe of the landscape.

However, unlike a typical two dimensional graph, we can assign parameters to points along the surface of this layer, and according to the relationships of these parameters to each other, can modify their shape according to proximity. This means, that where the anthropologic layer of a certain type (say, a coal power plant) is activated in the zone, it will work inversely to the layers of the meteorologic and the hydrologic. Now what was once a flat mapping of the status quo is a testable four dimensional scenario planner where designed impacts fluctuate the effects on the local environment for good or ill.

Parametric design allows layered thinking to merge information and architectural form into a synthesis, enabling circumstance and situation to dictate methodology. Rather than superficial analysis, identification of relationships within environments can be mapped into layers of overlapping systems digitally, analyzed and tested as layers of influence. Our view of the physical world then becomes a system of layers as we analyze based on our comprehensions of the computer interface. Knowing the method of input for site parameters then exchanges with the world view of physical systems.

The fluid systems of exchange in our physical world act in layers of influence, some with abilities to affect with more impact than others, but all contributing towards the creation of reality. However, our actions within the digital reality possess a simplified version, a selective version of the physical realities we are mapping. The designer’s role is exhibited as a mediator between the exact replication of events digitally and the abstracted processes of distilling information into calculable but unpredictable outcomes. This homospatial thinking, consisting of active conception two or more discrete entities occupying the same space, leads to the articulation of new identities and relationships in perceiving place.
The opportunity lies where emergence and parameters in architecture becomes materialized with the organic, circumstantial and ecological sensibilities it enables. Developing computational architecture requires dynamic materialism to compliment its dynamic form/space. As the formation of digital architecture is multiplicitous and circumstantial, so must its materialization. While precedents in digital design are most commonly materialized in plastic, seamless aesthetic, the flat sterile material quality only promises to alienate living beings from these barren computer renderings come to life.

These simultaneous formations in architecture methodology are both co-occurrence and opportunity. Material safety and energy reduction are only pragmatic constituents of ecological design. Methods of performance measurement promises to reshape the influence of environmental circumstance on architectural form. By blending these principals, we can begin to exchange with our surrounding in a meaningful and resounding way. Our comprehension of ecological systems is augmented by methods of digital technology which simultaneously harmonize and juxtapose their place.

Specificity in design is informed by site parameters, as well as specifically augmented by material parameters. The informed form is enriched by its sensitivities to phenomenon of the site, and phenomenon of material and phenomenon of technology process. Biologically, it takes on a role in the system of cellular exchange on a microscopic level by using properties of the ecosystem to determine its molecular constituents. Formally, the shape and tectonics provide insight into the characteristics of a place by highlighting qualities found particular to its locale.

On informed form

Within the steadily growing field of parametric design in architecture, a powerful method of creating and managing design moves has played a subtle but distinct role in form and space formation. By calculating information from analysis, real quantitative analysis itself becomes the tool
by which decisions are found. We may speak of solutions in terms of finding as is common in parametric design method, for multiple "architectures" exist within a given set of constraints and rules. However, rather than mere implications of rule setting, visual model deforms and modifiers exemplify the design intent without prescribing singular solutions. That is to say, as a chemist seeks a desired effect in a solution of constituent matters through a variety of tests, so does a designer create a framework for testing a variety of architectures for feasibility and fit.

Therefore, we can say that the outcomes of testing range in complexity and organization which are all based on combinations of variables informing the solutions. The form is informed by site particularities in much the same way that the same species of tree forms according to its locale. Along the eroded bank of a river, a sycamore will compensate its angled form for the unleveled terrain by asymmetry; the opposite sycamore of the floodplain will produce a wide root base with a straight thick trunk. The orders represent summaries as outcomes override.

Orders of systems are extracted from site. This is the genetic information of the system (genotype), internal workings of general types and compositions. Within a working system of biotic flows (nutrient flow, hydrological flow, geological flow, etc.) emerges an outcome variability that allows the system to adapt where the generalizations fail to accommodate. Meaning, where genetic code cannot compensate for specific forces, immediate mutations occur in the phenotype, or the environmental response.

How might we view this model of natural organization as it applies to architectural method? Perhaps an alteration in discourse will open possibilities to see design as a less prescriptive, top-down information flow. Rather, information arises out of investigation as to what is needed, where and how the site flows occur and to what extend those are adaptable to varying constraints. Programming genetic codes for planting seeds of design, initial steps for formation, uses the diagram of extrinsic forces in combination with the material methodology of intrinsic forces to write a code by which these forces coincide.
Here we see several new players in the composite design emerge as necessary components quite early in the formation of design. Firstly, where programming was once a list or document of prescriptions, now quite literally represents a code or a script by which precise measurements in model and mathematical form can be visualized. William Mitchell claims that parametric modeling itself is a form of programming and program testing by creating a set of relationships which are allowed to affect one another in ways that traditional programming inhibits. Rather than viewing each component of a design requirement as separate and distinct entities, the overlapping layers of design merge together, often creating single form solutions to multiple requirements. This is most easily exemplified in structural skins, or exterior building surfaces which share loading with internal reinforcement and partitions, but neither is solely responsible for one single task, as is the case in common “skin and bone” construction. The exterior membrane is now responsible for multiple simultaneous tasks, structure, weather protection, light emissions, air circulation, vegetative cultivation, water capture and purification, all of which create the “aesthetic of function” across the entire surface of the form.

Unlike the Pompidou Center in Paris, where the intriguing “aesthetic of function” is isolated into separate layers of systems, color coordinated as a CAD drawing, membranes draw from the intermingling of function within surface as apparent in a leaf. Here the emphasis of the form is concentrated on its porosity or the ability for free transfer of specific energies through the surface membrane and created within it. Programming is then seen as the merging of influences, informing the form.

The second important player introduced into the early schematic and development processes represents the craftsperson of material method. I consider these contributors to be extremely valuable in the reformation of materialism in architecture. Rather than generic, homogeneous material pallets based on convention of use, new architectural formations demand a heightened awareness of material properties and furthermore, a rigor in material method testing. Material method specialists, currently relegated to the title of pre-fabricators, offer the realm of design the control for tolerance specificity, fabri-
cation testing, process analysis and the growing importance of waste flow accountability.

With the emergence of BIMs (Building Information Model), a new era of information flow in design processes allows uniform information transfer to all elements of a design process. Architects or draftspersons once prescribed the information exchanged to project collaborators by notes or dimensions of only a fraction of a project's information, withholding a majority of the information necessary for a broad range of consultants. Now the form itself possesses the data required for conveying spatial and mathematical information to all contributors of a project.

The concept of informed form relies heavily upon a variety of inputs to achieve a comprehensive design that establish desired relationships. In fact, if the inputs of an informed form draw directly from surrounding contextual and ecological parameters, the realized design will become a model of building information. In this way, the informed form can be "read" and the imbedded information it possesses, both in design model and physical existence, can inform the interpreter. Deep levels of meaning in architecture are no longer relegated to scholars or historians, nor are self-referential acts of design hollow and void of realism, as illustrated in the post-modern work of Robert Venturi, et al. Informing the design are real, calculable and sensorial influences that frame the wholeness of an integrated system.

Re-examination of Site

We have established that complex arrays of inputs are possible in digital parametric design and also, that in order to establish a thorough connection to dynamic environments, a complex involvement of multiple constituents are required. We have also discussed that the dissolution of traditional planar surfaces capable in contemporary digital architecture can become coupled with green architectural practices of vegetative roof systems, promoting a biological design that is not relegated to the roof. As the layers of systems influence each other in positive reactions,
new possibilities emerge for how and where we as designers are “allowed” to venture.

Rather that limiting designs that base their form on the safe boundaries permissible by rules of reduction, the site of design moves beyond traditional building envelopes generated by stri-ating land. In-fact the site concepts of urban and wilderness are no longer applicable in the sense that they are disparate entities operating independently. Much of the American landscape has undergone dramatic transformations at the hands of human culture. Though they are perceived as urban, sub-urban, rural and wild, the wild areas have been specifically designed no remain wild, and therefore constitute our cultural landscape as well. The purposes for preserving the wild derive from our inability to live sustainably in the landscape, and that if these areas we not set aside from development, they would be completely overturned, the diversity homogenized and the biota annulled.

However, even our national parks are not free from infrastructure, as miniscule as it may be, that permits us to see this so-called “un-tapped natural resource“. Yet, in the urban realm, we focus on greening architecture to reduce our footprint on the earth, while rural developments still remain stuck in the industrial age and are slowly absorbed into the sub-urban sphere. Each of these interconnected sites has circumstan-tial rules (or lack-there of) on which the design parameters are based. None of these rules include positive returns to the biology in place.

If we were to design with positive biological re-enforcement, and to also use technological advancements in site data analysis to establish potential sites previously unprecedented.
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Bat House:
*An eco-logic design*
* & fabrication process*

Criteria and parameters for fit
Why bats?
- Clearing of dead and hollow limbs from trees destroys natural bat habitats
- Bats as natural insecticide help control summer mosquito populations
- Habitats in the wild promotes health in the wild

Why computer modeling?
- Bats afford opportunity for designing inhabited space as a "suspended surface"
- Zero gravity, placelessness of the computer design-space makes suspended surface modeling appropriate and necessary
- Computer modeling and animation enables the design to manage and test multiple organic context and form relationships
- Automated computer manufacturing produces the bat house simply and cost effective (around $2)

Site fit:
- 15' minimum from ground
- South-East, South-West side of tree
- No nail attachments (protects tree, preventative maintenance)

Organism fit:
- Entry from below
- No internal floor (discourage starling nests, self cleaning)
- Rough surfaces to hang
- Weather tight, natural materials
- Small tamper-proof opening (discourage squirrels and wood peckers)

Design Process

First, we begin with a general form which meets or will meet the first set of criteria for the bat, meaning it will have a narrow opening at the bottom, some form of cave-like topography inside and maybe the reflection of this form creates a water basin on the roof, etc. These circumstances are found through research of bats and their habitat, as well as the typical bat box as it relates to these factors. The NURBS at this point are merely noodles in Maya-space
which are created for the purpose of manipulating their parameters. Generically, it’s a sketch, which evolves into reality through imposed factors and conditions.

Secondly, these NURBS are lofted and the resulting surface is analyzed. An interesting thing occurs, even before material properties are assigned to these lines in space, it becomes evident that the model is skewed and warped. The resultant wires drawn between the curves are too stretched in places, leading one to believe that any fabrication of this object (and furthermore, the steps in and out of various programs, encoding and decoding surfaces to achieve fabrication) will prove this form very difficult to work with and not a very good ‘fit’.

Third, these conflict surfaces are resolved, and the form takes variations accordingly. Now the surfaces are shaded and a better spatial sense helps resolve criteria for habitation of the dwelling. These might include stretching or collapsing areas of the volume where it feels appropriate. The position and shape of the entry crevice also is adjusted to keep out starlings and to ensure that the floor of the dwelling will not collect wastes (self-cleaning).

From Maya, the model is taken into 3D Studio Max, where it can be affected by different stimuli. Perhaps we imagine that this form will push up against a tree, and that the generic form of the tree will resemble a slightly convex flat surface. If the form is morphed to the tree surface correctly, we can presume that the object will be “adopted” by the tree surface as it grows around it. This allows the form to literally become the site and replaces the need for conventional attachments.

As the form is affected, it becomes apparent that the internal volume needs to morph again, to counteract the tree, and as such it given its own force of resistance. The sequence is analyzed and what is determined to provide the ‘best fit’ is chosen.
From here, the model is taken into Rhino 3D and sliced for fabrication. These slices represent the material thickness of the prototype, and the resultant sections are laid flat. The sections are imported into AutoCAD where they are offset to give thickness and laid out to fit the limits of the laser printer, 24”x18”. By nesting these forms together, fewer sheets of material are required and, as a judge of material economy, the bat dwelling is fabricated from less material than the conventional nail and 2 x constructions. The sheets are exported to Adobe Illustrator which is the format for laser printing and appropriate steps are taken to refine the file for the cutting process.

At the outset of the fabrication process, a definite direction of hand-modeled tactility was desired. This synthesis of production (or by-production of investigation) led to two interesting experiments. The first, a corrugated paper skeleton is assembled from the sliced laser prints, and assembled to create an evocative, transparent blob. Here, the sections are represented directly and the use of computer design and fabrication is evident.

The second by-product is the result of desire to express an enclosure to the surface, as it was originally intended as a surface model, not a skeletal model. Here, "low-tech" vernacular production processes are introduced, which lend themselves to the idea of the uniquely crafted more than modern standardized production practices. A method of candle-making is employed to slowly coat the skeleton with wax. By dipping the skeleton into hot wax, letting the wax cool and repeating, a coat of liquid surface slowly builds onto the form and soon enclosed the space. The computer-space modeling and animation of the form, as well as its finish surface material, enhance the effect of surface fluidity in the design.

With regards to the critique of blob-form architecture, that it produces an unsettling aesthetic in contemporary anthropocentric spaces and that its appearance is so remote from our typical conventions of dwelling, then we must shift our design center to that of other organisms in need of habitat.
Informative-scape:
Spatial flow mapping and informative installations

The informative-scape is a design collaboration with Robert Horner during the autumn of 2005. We perceive a specific social artery on the Ball State University campus as an opportune space for an installation that could test our theories of three-dimensional diagramming, informed form based on pedestrian flows or pedestrian perceptive states, and finally examining the digital process from form-finding to digital fabrication. The framework for our understanding became analysis of the nearby White River as it was analogous to the social artery flow. The objective for the piece maintained a commitment to cultural ecology change through qualifying data about global environmental crises.

Just as a stream is a concentration of water energy, transportation flows are major concentrations of people. A much about the ecological balance can be derived from analyzing the river, because of its ability to index the circumstances of its watershed. If certain chemicals are used in fertilizing area agriculture or suburban lawns, traces of these chemicals are apparent in the waterways. The same can be said for our site. As a measure of our culture, we can derive much by analyzing certain aspects of our transportation routes, where populations are concentrated. Because much of the human transportation in this area takes place in a semi-private automobile, which also has the capacity to take multiple persons simultaneously, this particular site offered ability to analyze a mostly pedestrian transportation route one person at a time.

A second consideration with regards to siting includes the idea of “between places”. Ball State campus exhibits very little connectivity in its building siting and therefore the outdoor spaces are often thought of as “leftover”. We feel that the forgotten aspect of “the outsides” by design leads inhabitants to assume an equal disregard for these spaces. Through the subconscious, actions of the designers encourage or discourage the use and the kind of use in a particular space. In short, neglect breeds neglect. Our attempt is to bring a sense of place to a forgotten space in a heavy pedestrian traffic flow, and
use the guidance of the river analogy.

Pedestrians were measured according to quantity, time, path and device (single pedestrian, conversations, bicycle, headphones, cellular phone and automobile). The resulting diagram categorizes the quantity of people at a given sample section by area of the artery cross-section during peak times and off-peak times during the hour. The shape of the artery indicates the device of the pedestrian and is traced along a calculated path. Therefore, the model can be sliced at any given section in the space and analyzed for its contents and placement during a given time. The artery type and size informs the success-rate of an information display placed in this zone or along this intersection.

Installation within the spaceflow acts as a test to which the observers measure or calibrate the cultural, ecological and technological systems imbedded in the movements. There may be a series of formations which respond to the first two systems in order to clearly illustrate the third. Therefore, installation into this system will make apparent the presence of the cultural and ecological elements coherent in the space-flow, responding to the needs of certain aspects of the population such as the desideratum for communication, social connectivity, substance dependency, audio-sensis, transportation mode, etc.
Informative Installation:
Channeling flow, filtering and reanalyzing

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The installation acts as a multimedia exhibition gallery, which contains information focused into specific causes of cultural and environmental sustainability. Using campus sustainability groups and community conservation organizations, such as the local Audubon chapter, as well as integrating campus artists, the installation revolves various issues in the local and global efforts for environmental awareness. The informative-scape may be focuses on global deforestation one month, and local watershed pollution the next.

The objects within this field of flow channel the energy of the pedestrians with continuous fluid surfaces blending the interface of information into a spatial organizing pattern developed out of the artery diagram. The organization arises directly from the analyzed system flows and responds with three types of interfaces. These interfaces are powered by photovoltaic skins wrapping the surface of the installation where applicable to solar energy and occur on the elements where electrical power is necessary.
The first interface type recesses into the surface in a series of stationary events, windows into the structure that house a variety of static objects or images, potentially viewed as a gallery for student sculpture, painting, printing, etc. These scattered events have a frequent occurrence through the space, as they require little energy from the electronic systems of the piece and exist independently of the “main grid”. The windows offer a personal interaction for single passing pedestrians.

The second interface type uses light projection and sound projection information. Video and photo are projected onto the surface of the skin from within and are given viewing “hoods” where glaring from the sun or an artificial nighttime light is an issue. Audio projection events are localized to personal listening stations where poetry, prose or non-verbal audio captures the essence of the installations message during a given period of awareness. The projections offer quick glimpses across the skin of the installation for pedestrians on bicycle, automobile, cell phones or headphones.

The third interface is developed at an interactive experience operated by one or multiple pedestrians at a time. These pods exhibit the highest degree of technological input and therefore anchor the information-scape in key, centralized places. The forms of the pods are developed externally by solar energy and precipitation channeling, while internally by the proportions of the human body. Artists from the university’s telecommunications department create “Flash” animation interactions that navigate a user directly. The pods are designed for extended interfacing by singular of multiple pedestrians during “off-peak” times of the hour.
River Subface:
Indexing, cleansing and illustrating ecology

In partnership with Sandeep Arora’s experimentation with glass and light filtration based on waves patterns in water.

Through the use of image mapping in the computer program Rhinoceros, we take a grayscale image, and according to a given grid of sample points, extrude form from the percentage of gray at the sample. It is then feasible to light a given surface in a photograph enabling an accurate extrusion of topography to occur. In the first study, a photograph of an underwater rock surface it dodged and burned to contrast the topography in order to accurately model the surface. The resultant surface is a loosely fitting contour of the underwater form, as if it were a diagram of the water flow over the given area.

From our flow diagram, it is also possible to map the flow of substance in the water across the surface in order to test the theory of fit. Perhaps in fabrication of the surface, it is charged or attractive to particulates in the river with electromagnetic fields. By doing so, our surface becomes a surrogate riverbed which indexes the water pollution and sediment, filtering the water. Perhaps too, the material cast exhibits an alkaline quality that balances the acidic runoff in the streams and rivers. In cooperation with Sandeep, we choose to recreate the effect of being underwater by mapping the river’s surface and the river’s subface and investigating the effects of digital manufacturing on organic form.

The Surface/Subface (or “under-face”) uses each panel as a test to reveal different qualities of the technology we employ to abstract the natural system. For instance, the tool paths are conscientiously left and the bulge of the bit grooves expand and contract across the pieces. While the shape of the subface is generally similar for all panels, they play with the cast concrete in unexpectedly beautiful ways.
This fabrication consists of a foam milled template which contours the river bed in a given section, and then receives a poured surface, first of concrete, then reusing the forms for tests in plaster of Paris. The foam mill can be melted into another sheet, reformed to represent yet another section of the riverbed. In this fashion, several of these cleaning surfaces can fabricate from a single piece of 4 foot x 8 foot foam board. The plaster of Paris panel is laid back into the place where it was extracted to serve as the surrogate surface.
Enmeshing ecologies:
Bridging boundaries of space & hydrology

Mounds State Park - Anderson, Indiana: working in collaboration with students in the Virginia B. Ball Center for Creative Inquiry

We begin to recognize our place on the earth. We begin to understand the frequencies and rhythms of systems. We can begin to weave our existence into the orders of the uncontrolled dynamics of nature.

The Mounds State Park, located in Anderson, Indiana, is a state organization of ecosystems and cultural artifacts. Within this organization, certain criteria for human habitation and the necessity to preserve recent as well as ancient histories of the place prevent these ecosystems from fluid operations. Trails, boardwalks and bridges, as well as maintenance infrastructure attempt to place the human body safely in the landscape, yet poorly planned events lead to serious repercussions. Park solutions reduce the erosion of the earth, yet only serve as temporary, unstable resolutions to the surface degradation.
The point of departure for this project looks to the site for design queues, generating diagrams of our understanding by which the land has a direct, inexplicable connection to the form, and therefore the installation. Methods of hydrology mapping investigate slope as a continuity of the river, and seeing the river as an index of the land, its uses and its inhabitants. We read the site through the medium of water, and we read the land through the medium of the river.

Conceptualizing the land as a series of morphing channels, the bridge structure consists of cells, defined by our diagrams, each carrying a capacity of water which meanders in slowly alternating courses over and underland. The cell walls become the recycled plastic ribs by which foot traffic is permitted to pass, while the cell contents filter water, raising the pH level with the use of naturally basic and locally harvested limestone.
The recycled plastic provides several major benefits to the project. The first benefit being a new, experimental use for a material often specified by the Indiana Department of Natural Resources. Secondly, the use of recycled plastic generates positive economic rewards to the plastic recycling industry, potentially creating new uses for one of the most popular recycled materials. Thirdly and biologically, plastic lumber requires no chemical treatment to preserve it, as with treated wood lumber, often times containing concentrations of arsenic that leaches in the water supply. In these ways, the bridge no longer separates the human being from the dynamics of nature, but integrated them, literally and figuratively, with the structure of the installation.

The surface of the bridge receives a treatment of routed patterns which aid in foot traction as well as draining surface water into channels. Our precedent for this traction and water control comes from analysis of tire and shoe treads, while also testing performance of different routing techniques, forms and the directionality of the texture. In this way, we reveal patterns of use as an aesthetic, while processing locally recycled products with a new sensitivity towards surface.
At the riverside edge, the routed planks curve up to reveal the limestone filter below, and the ground surface become a frame through which we are able to view the river. Seating specifically located to position the viewer at the apex of the rivers bend, and weave the panoramic landscape into a composition by use of vertical elements. Between these elements, we anticipate an educational interface which processes approximate substances, specific materials and objects found within the ecosystems, into a real and tangible matrix of biotic constituents. Rather than imagery and signs of the natural elements found in the park, as currently exhibited in the park’s Nature Center, found organic materials from throughout the landscape are processed into a framework on the river edge of the bridge according to seasons or events.
Intergrowth patterning: encoding & breeding geometries framing environmental outcomes

Minnetrista Cultural Center: working in collaboration with students in the Virginia B. Ball Center for Creative Inquiry

In partnership with A. Zahner metal fabricators, Kansas City, MO & SHoP/Sharples Holden Pasquarelli, New York City.

The installation at Minnetrista is located where we see the interaction of several powerful phenomena. The first is a plateau, where the formation of the White River reaches its northernmost extent, coinciding with the high point of Delaware County. Secondly, the site exists as an artifact of the aboriginal culture of the area, where an extensive settlement existed. Thirdly, the site presides as the crest of the Muncie city aristocracy of the 19th and 20th centuries, where the mansions of the elite perch upon this rise. Fourthly, Minnetrista embodies the cultural and historical ideologies as a time capsule and a catalyst for interaction between layers of meaning in the landscape.

A strong dichotomy exists between the factors of fluctuating natural orders apparent in the river, and the striation of the land by human historical and cultural influence. The installation exists as surface of influence between these forces. The form is informed by parameters of light, vista, material and process through a method of digitally folding and perforating sheets of steel to enable a self structuring membrane which rises
and falls from the plateau edge. This edge is demarcated by a swath of prairie grasses, rising and falling in their own cycle. A screen of 15 weathering steel sheets stretches for 51' across the boundary of the human order and the encroaching erosion of the natural realm.

Generating form arises out of circumstances of site as it pertains to the vista, screening the landscape, and reflecting the sky. Combinations of fold types are arranged by modifying a single fold pattern in four variations. These fold plans can then generate several variations based on fold direction. From here, a kit of twelve pieces are combined to create a variety of effects, analyzed for their ability to self-structure, anchor to the ground, as well as reflect, screen and frame the view.

A plan diagram of potential vistas and reflections is created by a warped grid of view lines along two existing paths on the site. Movement along these paths set up a series of constructed views through the trees, reflecting the sky and framing the horizon beyond. Based on the plan diagram demarcating the angles of view, paths are shaded according to the number of objects interfering with the view; the geometries are combined to produce desired effects in specific placements.
From the initial generation of geometry pairings, well "adapted" pairings are spliced from the parent and "bred" with similarly fit geometries. The fit of these pairs is based on the relationships between the form and the desired criteria of reflection, screening and framing. To properly combine these pairings, several mutations occur (indicated in red). The process is by no means exhaustive and new arrangements can occur through re-breeding the geometries for different environmental criteria, or reconfiguring the family tree from new initial fold plans.

Perforation strategies emerge from site’s generative considerations (vista/screen/reflect), and connection details. Allowable perforation punch sizes range from $\frac{1}{2}'' - 2''$ in diameter. The patterning ranges are developed by merging images of the river surface flow with tonal ranges that pair with the desired transparency of the metal surface. Water surface images were chosen for the non-uniform distribution of tone. Light tonal areas create small punches, which act as pinhole apertures admitting small streams of light on the shade-side of surfaces. Dark tonal areas create larger punches and relate to the vista beyond. The water composite image is rasterized in a half-tone patterning and converted to computer modeling data with RhinoScripts. Punch diameters along the connection segments become modified to create connection holes.
Conclusions & Future Implications

The future of digital resides in the biological

For over a decade, architects have predicted a threshold into a new realm of digital design, which promises to revolutionize the model for how things are perceived, analyzed, formulated, designed, fabricated and critiqued in architectural discourse. During this time, great steps have been taken to push the technology enabling these revolutions, ignoring the precepts of reality for the intense digital exploration and interrogation. The information capacities capable in architectural design today are being ever increased, yet the ability to fill these capacities with viable and worthwhile information seems to suffer. We may speak of the complexity in design without actually approaching this complexity if it remains immaterial, un-made and un-realized in a physical state.

We as architects and students of architecture have no shortage of real and immediate issues of social and environmental crises in our contemporary world. Therefore it is imperative that we release our digital tools from the grips of disconnected “play” and use them to our fullest ability for positively impacting the environment around us. We have indeed only begun to cross the threshold, yet we are only beginning to realize our potential.

Enmeshing ecologies serves as a touchstone for future designs that account for all factors of a design environment as equal participants in the formation of the project. Through digital analysis, these factors become simulated in 4-dimensional space, with adjustable fields of influences and hierarchies, as developed in Informativescape. Internal parameters of material investigation and external factors of dynamic environmental constraints are generative devices, developing a surface imbedded with a variety of characteristics exhibited by Intergrowth Patternning. Digital tools of analysis and fabrication augment our view of natural systems, striating the flow and then smoothing it again, as one would catch and release a fish, giving the River
Subface back to the dynamic force that shaped it. Finally, architecture steps beyond anthropocentrism and investigates the potential for design of non-human clients, who are allowed to affect design within an established framework, the design of a Bat House.

Still, there are trade-offs with regards to the materialization of architecture and the impact we have on the environment. We must use energy to make energy, while also working within the constraints of our limited, "dumb" materials which are governed by capital industrialization and not ecological safety. As such, the new frontier of digital ecology design resides in the investigation of material, not only for healthful benefits, but searching for a maximization of the effect of matter and tectonics in digital product. Digital architecture has achieved a growing vocabulary of form which requires rigorous material investigations to realize our designs. It is here that architecture will synthesize the framework for digital materialization with an ecological sensitivity becoming imperative in contemporary architecture.
Works cited


