

RUNNING INTERFERENCE: COMPLEX SYSTEMS INTERVENTION AS DESIGN PROCESS

CHRISTOPHER BEORKREM

*Assistant Professor, UNC Charlotte, School of Architecture, USA
cbeorkrem@uncc.edu*

Abstract. This paper presents a case study problem statement tested in the design studio with the intent of teaching methods for engaging systematic thinking as a process for deriving solutions to parametric design problems. The intent is to address the simulation environment developed through complex systems and interject a curve ball, or unexpected constraint delimiting the solution as part of the design process. This method was tested through the submittal of the projects to international design competitions. The students were asked to manipulate the competition criteria by appealing not only to the design criteria but also to the juries desire (whether conscious or unconscious) for novel sustainable processes of material usage and program. This material ecology is developed as a method for linking parametric modeling, not as a process for the application of a construction technique, but as a way to pre-rationalize material constraints and discover how program and form can operate within those constraints. In the first year of the studio two of six teams were selected as finalists and in the second year of the studio five of seven of the teams were selected as finalists.

Keywords. Studio Pedagogy; Computational Instruction; Parametrics; Material Constraints.

1. Introduction

As response to post- great recession expectations and as a natural arc of the evolution of design process, designers are in the midst of a struggle for clearer control over the parametric relationships, which govern our design process. There is undoubtedly a new pragmatism formulated through more meaningful responses to process fostered by the excess and flippant use of digital manufacturing equipment and the incredible flexibility of design software. There is a clear desire to explore how design process is being redefined by complexity through software. The question remains how can

the machine give us new solutions to problems we didn't even know existed, and how can it allow us to redefine the processes we use to assemble building components? This new functionalism has been a long time coming, though it is much more broadly accepted in times like these. However, the delimitation of process has been accelerated by the wide use of parametric software, providing more flexibility with every new software update. As a response to this apparent trajectory, this paper will demonstrate a design process and problem statements intended to develop students skills for systems based thinking, helping them re-shape their own design process to respond to computational design and complex systems. These problem statements define a method for investigating the layers of design process by impregnating the process with a foreign agent, capable of delimiting the design proposal through detail and materiality. The intent of these projects is to provide students with the ability to not just work with computation, but to understand how computational process can delimit outcomes, and how it can provide solutions through refinement of function (whether social, material, economic, or political).

As far back as 1993 Juhani Pallasmaa was recognizing (and arguing for) a new "eco-functionalism" (Pallasmaa, 1993) derived through the parameterization of technology, materiality and form.

Today...I cannot imagine any other desirable view of the future than an ecologically adapted form of life where architecture returns to early Functionalists ideals derived from biology. Architecture will again take root in its cultural and regional soil. This architecture could be called Ecological Functionalism...this view implies a paradoxical task for architecture. It must become more primitive in terms of meeting the most fundamental human needs with an economy of expression and mediating man's relationship with the world...and more sophisticated in the sense of adapting to the cyclic systems of nature in terms of both matter and energy. Ecological architecture also implies a view of building more as a process than a product. And it suggests a new awareness in terms of recycling and responsibility exceeding the scope of life. It also seems that the architect's role between the polarities of craft and art has be redefined...After decades of affluence and abundance, architecture is likely to return to the aesthetics of necessity in which elements of metaphorical expression and practical craft fuse into each other again; utility and beauty again united. ¹ (Pallasmaa, 1993)

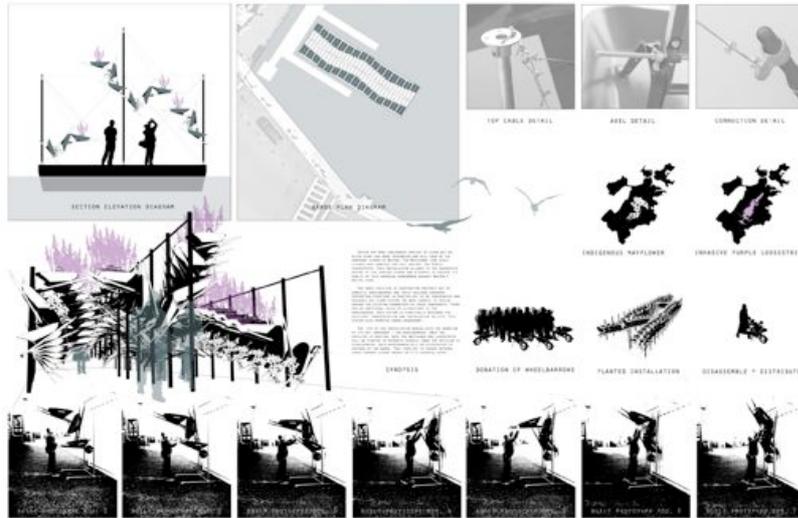


Figure 1. Shift Boston Barge 2011 finalist competition submittal using wheelbarrows as primary construction system.

Few would doubt the growing importance of computational methods and thinking within architectural design, but what remains unclear is how a discipline such as ours can *become* computational. How do we arrive at the point of integration, when architects understand that computation is not just a tool, but a method for design? When all designers, not only specialists, can practice computationally and ruminate on the subject? Our goal is to trace possible trajectories and delineate obstacles on the way to making computation not the exception but a normative part of our methodology. The success of this transformation rests on something greater than the adoption of a particular level of vocational skill. It requires a cultural shift. As education is one of the primary instruments of implementing disciplinary culture, we must work to instill alternative values, attitudes, and beliefs regarding design through our studio pedagogy.

2. Systems for Interfering

Parametric processes have broadened to encompass a variety of relationships between form and space: through inventive use of the algorithm to develop indeterminate forms, through parametric controls linked to material constraints, through political parameters as they relate to the identity of a form, through New Structuralism² or the linking of parametric forms to their structural composition, or as a map of the social

identity of place. In each instance there is an ethical question about the humanistic value of each process. How in the end do these relationships create the phenomenological experience good design is capable of providing?

The kind of systematic thinking or evidence-based design that Pallasmaa was called for takes on the kind of complexity, beyond the scope of most designers capabilities. These type of systems are defined as “complex systems” by mathematicians and computer scientists searching for a method to address and investigate layered relationships. Typically these involve simulations no human would be capable of solving, or simulations, which are emulating human activities. For design process, we require the foresight necessary to compose a design, properly engaging all of the necessary systems for both ethical and inventive solutions. The closest that we can attempt to come through conventional means is an idea proposed by Mario Carpo (Carpo 2011), would be through the use of collective intelligence. Rather than relying on a select system defined by particular invested parties, whom often have political or economical motivations, we ought to rely on a system of competing parties, arguing for best practices at that point in time, and for that location.

As a response to this question, we developed a design studio problem statement, proposing a methodology, which emulates this functionalist or logical approach. This requires first that the students have a baseline problem, in this case a carefully chosen international design competition. A design problem for a temporary installation functions best, for reasons outlined below. The two studios outlined in this case study used competitions for *TOGS3 (Temporary Outdoor Gallery) Competition* sponsored by the *Austin Arts Alliance* (2010), and the *Barge 2011 Competition*, sponsored by *ShiftBoston*. The baseline for this design process is the program and competition statement for each of these competitions. The programmatic definitions, as with most competitions, are quite varied and rarely offer much in the way of constraint. The temporal nature of each of these competitions provides more flexibility in the use of unconventional materials, both recycled or what we call *pre-cycled* (the purchase or donation of a new product which can be donated once the project is disassembled). By entering competitions the students are made to consider the client as someone who can be influenced by the tertiary layers of the design proposal, the layers which may not have direct effect on the form of the project, but which carry cultural or societal significance for the place or purpose of the project.

3. The Secret Agent

As an essential part of the design process, on the first day of the studio each pair of students is assigned an off the shelf recycled or pre-cycled component. Each of these materials allows the students the ability to argue that there is very little actual new consumption occurring on behalf of their design proposal. These material agents have varied including, wheelbarrows, 24' 2" X 4" trusses, traffic cones, 55 gallon steel drums, tires, radio flyer wagons. The objective of the material agent is to force the students to engage with a seemingly overwhelming amount of constraint. The fact that they are required to use an off-the-shelf unit, often devoid of architectural typology or precedent requires that they develop a truly novel method constrained by a material parameter.

Through the development of this architectural system, they learn how to use digital manufacturing equipment in responsible ways, minimizing customization while maximizing form. These tests are developed through a variety of ways, at first simply by disassembling their unit, and exploring how it can be reassembled into other more spatial ways. Then through a series of both physical and digital models, using the constraints of the system to determine how a form could be applied at the scale of the competition program, or more specifically at the scale of the human body. Each iteration must be described in section to examine how the human body can safely inhabit the structure but also must be designed for disassembly, so that the original unit can be reused in a more conventional manner.

The process of designing for disassembly is crucial to our pedagogical perspective on the teaching of performance-based architecture as defined by more than the simple building product. It is composed of a complex set of systems, both technological and cultural, made of physical commodities and human effort. Ultimately, the designer is responsible for coordinating this discourse; responsible from the point of conception to the destruction of the building. This responsibility includes not only how the building performs throughout its life- cycle, but equally how it performs during construction, through adaptive re-use and in its eventual demolition. We must consider every commodity consumed in the production of building products as a part of its design. The EPA (EPA, 2009) reports 331 million tons of construction and demolition waste and debris was generated in 2008. 60% of all landfill waste is a result of the building industry (not including waste from civil projects such as bridges, roads, subways, or rail systems.)

“We need buildings which fulfill their task today and will do so tomorrow, which in other words, do not age in adhering to their forms and this becomes a drag upon the economy as well as the visual environment. But in order to build adaptably we must try to build as lightly, as movably, as possible and with the greatest perfection technically available” (Larsen 2003).

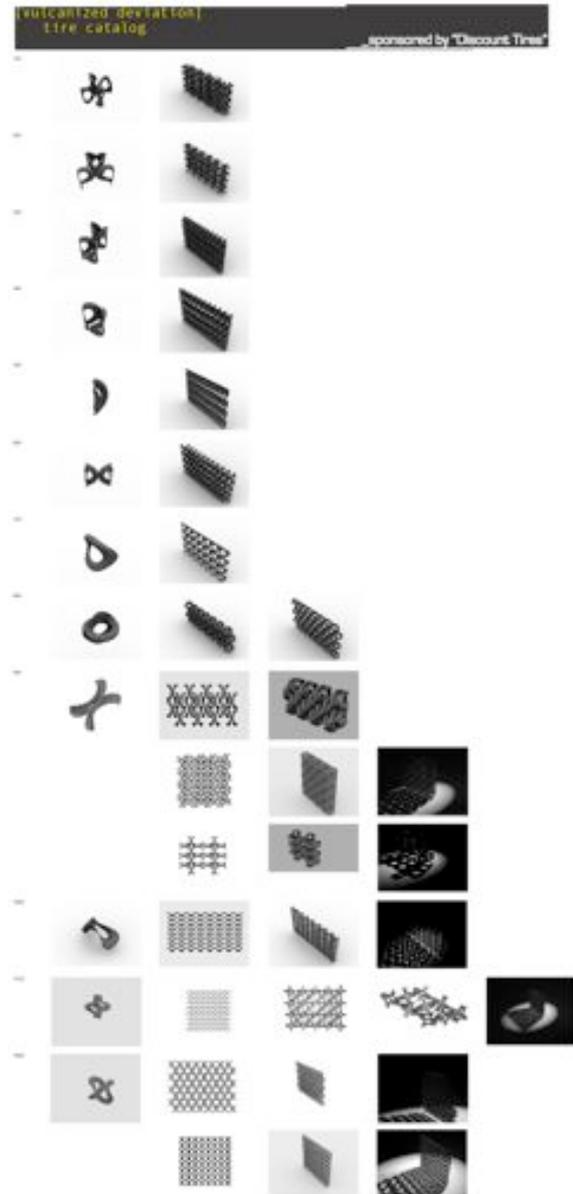


Figure 2. Iterations of sliced reused radial tire systems for the TOGS3 Competition.

Each assembly is presented in the competition submittal with the intent of appealing not only to the design sensibility of the jury, but also to other more existential desires. As Pallasmaa argued the ecological system can (and should) be motivated by political awareness (Pallasmaa 1993). These can be political, social or ecological agents, but that each needs to be tangible, not metaphorical. In most instances, the materials were either recycled or pre-cycled (as defined earlier). We attempted to minimize (and make a big point of it) any new consumption for the sake of temporary construction. The material components, also come loaded with an identity not typically associated with design. We use this identity to relate to other publicly supported entities. These entities can be anything from an endangered species to a local non-profit. For instance, the wheelbarrow installation proposal for the *Barge2011 Competition*, was filled with the endangered Mayflower, the State flower of Massachusetts. Alternatively, the proposal constructed of 24' trusses would be deconstructed and donated to a local chapter of *Habitat for Humanity*.

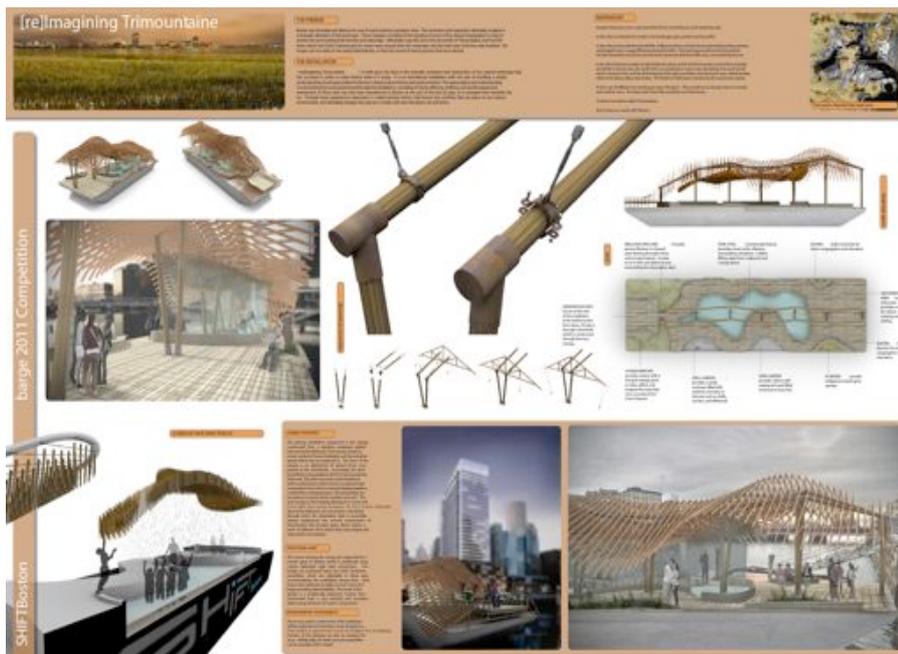


Figure 3. Shift Boston Finalist Competition Submittal using 24' gable trusses as primary construction system.

Our social goals for the project statement were focused on maintaining human usability and insuring that the identity of the original object was

maintained. The identity of the object can be used as iconography for the program of the facility and can/should draw attention from a public whom might be more prone to recognize an interesting use of traffic cone over a compelling conventional architectural detail, or even a highly customized digitally manufactured one. The haptic use of the material agent as a piece of furniture where the public is more likely to touch and manipulate it creates an environment where the users have the experience of place more substantially embedded in their memory. This can occur both through tangible connections but also through programmatic ones. The other finalist for the *TOGS Competition* used 6" cylindrical ductwork (again to be donated to Habitat) to create a sound based installation where voices would be transmitted through the wall cavities to other locations on the installation, creating an interactive and layered experience.

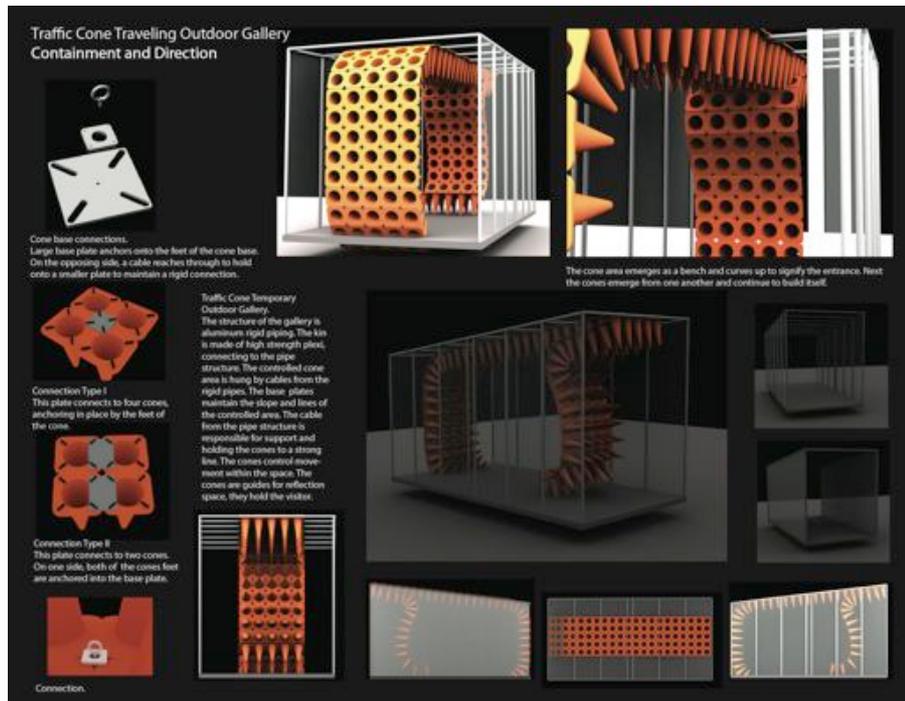


Figure 4. TOGS3 (Temporary Outdoor Gallery) Finalist Competition Submittal using traffic cones.



Figure 5. TOGS3 (Temporary Outdoor Gallery) Finalist Competition Submittal using duct work to create auditory connections through the walls of the installation.

4. Conclusion

The design problem outlined here creates a culture of creativity in the studio, which considers all parts of cultural life as valuable and integrated

systems for logic and evidence based design. Computational discourse is clearly manipulating the methods that we use to design and construct. This type of thinking ought to be linked to ideologies with more meaningful connections to our experience, than most of the flippant aesthetically motivated design we see today. Our intent with these proposals is to demonstrate a process whereby computational thinking can afford the designer the ability to create their own parametric relationships, through more meaningful connections to materiality, consumption, political and social identities and evidence based ecological awareness.

The competitions for these case studies had nationally and internationally recognized jury members. Of the six projects submitted to the *TOGS3 Competition* two were selected as finalists and of the seven projects submitted to the *BARGE2011 Competition* five were selected as finalists. By the nature of recognition these projects create invaluable experience for students to understand the importance for creating a meta-narrative for their own design methodology. More importantly it gives them the experience to consider how parametric thinking can connect form to something more than a shopping list, but can reconnect us to what we do well, make *design* for *people*.

References

- Carpo, M.: 2011, *The Alphabet and the Algorithm*, The MIT Press, Cambridge.
- Environment Protection Agency (EPA): 2009, *2008 Sector Performance Report*, 41.
- Larsen, K., Popovic, O. and Tyas, A.: 2003, *Conceptual Structural Design Bridging the Gap Between Architects and Engineers*. Thomas Telford, Nashville.
- Oxman, R. and Oxman, R.: 2010, New Structuralism: Design, Engineering and Architectural Technologies. *Architectural Design* 80, no. 4, 14-23.
- Pallasmaa, J.: 1993, From Metaphorical to Ecological Functionalism, *The Architectural Review*, (June), 74-79.