

Literature Review in Progress:

Defining Responsive Architecture:

Negroponte, N.: *Soft Architecture Machines*, Cambridge, MA: MIT Press, 1975. 239 p., [ISBN 0-262-14018-7](#)

Beesley, Philip; Hirose, Sachiko; Ruxton, Jim; Trankle, Marion; Turner, Camille: *Responsive Architectures: Subtle Technologies*, Riverside Architectural Press, 2006, 239 p., [ISBN 0-9780978-0-7](#)

Sterk, T.: 'Thoughts for Gen X— Speculating about the Rise of Continuous Measurement in Architecture' in Sterk, Loveridge, Pancoast "Building A Better Tomorrow" Proceedings of the 29th annual conference of the Association of Computer Aided Design in Architecture, The Art Institute of Chicago, 2009. [ISBN 978-0-9842705-0-7](#)

Article: Exploring Responsiveness in Architecture

Kolarevic, Branko, and Parlac, Vera, eds. *Building Dynamics : Exploring Architecture of Change*. Florence, US: Routledge, 2015. ProQuest ebrary. Web. 25 October 2016.

- We can expect buildings not only house and facilitate various modes of human activity but also adapt, behave, respond, and accommodate the flows of energy and information
- Architecture should be a “living, evolving thing”
- Architecture as a responsive and productive participant in a larger ecology
- Technologies have progressively shifted the view of architecture as a responsive and productive participant in a larger ecology
- Banham’s arguments orient architecture towards adaptive environments
- Weinstock – Dynamics of fluidity through the concept of nature as a source of interrelated dynamic processes
- Dynamic environments should not only address kinetic movements, but also includes flows of energies, material, and information
- The responsive architecture system could act as ecologies themselves, allowing architecture as a discipline to recalibrate its role in the larger socio-economic context by becoming a more intelligent and operative participant... a participant imbued with foresight
- Mechanisms that control and activate the intelligence of the physical environment
- Architects are first and foremost system designers – Gordon Pask
- A truly responsive environment should not only sense and respond but also perceive and act
- Mediating the local environment
- A distributed system that can facilitate the circulation and gathering of people
- The availability of [smart] materials offers an opportunity to design material behaviors as opposed to choosing materials on their properties
- This would alter the way we design: it would require us to relinquish control of the design process (understood in a traditional way) and find ways to change the material

- transformations to produce equally rigorous and reliable architecture, but only more aligned with its own materiality and larger ecologies
- The process of designing responsive environments relies on flows and dynamic behavioral patterns
 - Ed van Hinte – Architects should see themselves as programmers of a process of spatial change... creating a field of change and modification that would generate possibilities instead of fixed conditions

Current Avenues of Exploration in Responsive Architecture:

Maragkoudaki, Anna. No-Mech Kinetic Responsive Architecture: Kinetic Responsive Architecture with no Mechanical Parts, IEEE, 2013.doi:10.1109/IE.2013.23.

- Hygroscopic – Absorbing moisture
- Anisotropic p non-uniform 3 axis deformation

Towards a “Liveliness” in Architecture:

Lynn, Greg. *Animate Form*. New York: Princeton Architectural Press, 1999.

Beesley, Philip, Omar Khan, and Architectural League of New York. *Responsive Architecture: Performing Instruments*, vol. 4, The Architectural League of New York, New York, N.Y, 2009.

- Cedric Price’s and Joan Littlewood’s unrealized 1964 Fun palace...it was a representation of architecture that could never be finished
- Price seemed to see the actual provision of enclosures as a rather secondary issue compared to the crucial question of where something can be at a certain time
- Nicholas Negroponte’s notorious 1973 “seek” installation, a project inhabited by gerbils and aluminum cubes
- The Fun Palace was conceived more as a tool than a building
- If we agree that all good architecture modifies behavior in some fundamental ways, perhaps the lesson of the Fun Palace was that it offered this control as a feedback system
- The Fun Palace was responsive due to its ability for users to reorganize and alter their demands based on their activities...a framework for interaction rather than enclosure
- The building as a tool conditions our behavior but it also serves our changing intentions
- Demonstrated an architecture of process...
- The implicit claim is one of salvation from our excesses through better management and preservation of our environment. I am concerned with the limited imagination we tend to project within these technologies. They tend to be domestic and put to dutiful service.
- Lawrence Halprin’s Lovejoy Plaza and Cascade of 1966

- If nature implies loss of control, then perhaps Halprin wanted to hover at a brink, at the edge of solid urban ground, stepping toward wilderness.
- ...audience and performer would constantly trade roles, fostering a deliberately unstable kind of interaction
- Price and Littlewood seem to be orchestrating action itself, with scant concern for a permanent stage.
- Halprin's fountain alludes to natural forms and processes to engage inhabitants; there is something familiar in these forms, maybe even primordial. Perhaps that is the resistance that you find compelling.
- Halprin's passive counterform uses very different technologies than Price's focus on tools and process.
- The participatory purpose stems from a desire to develop a greater mutual relationship between people and their environment...architecture means to develop this engagement rather than separation...traditionally there is a boundary or controlled threshold separating the unruly outside from the domesticated inside.
- The wild offers that and its "precariousness" is a quality we yearn for in mutual relationships.
- Perhaps imagining conversation instead of information exchanges between inanimate things like architecture could be a more satisfying model for design
- In Price's and Halprin's projects...performance activated their works... like a proscenium in theater
- You've characterized a theatrical environment as an "interface" and a set as an "instrument" "Living Theater"
- There is something precarious about the fields you have made...operating near failure
- Hylozoic Soil demonstrates an environment at once indifferent like the jungle but also capable of registering collective resonance
- The audience interfaces with the proximity sensors and kinetic parts while the architecture responds by sending vibrations throughout the whole structure...individual interactions change the resonance of the larger collective surface
- The physical elements are stretched near the point of individual collapse, giving a quivering, vulnerable physical presence
- Real time sensing so that they can respond in nuanced ways to inhabitants' perturbations in space
- Using your term, they "resonate" the space by maintaining variety which in turn provides more possibilities of interaction between inhabitants...an artificial ecology
- Ignasi de Sola-Morales spoke of "weak" architecture...architecture hovering at the edge, deliberately holding back from trying to capture and anchor a situation...suggesting that the ability to resonate and amplify situations was ultimately far more potent than strategies of control.
- Withdrawal to a position of faint edges
- Investing kinetic and "intelligent" interactive systems with vulnerability
- I think the fragility provides a strategy for allowing an architectural structure to embrace multiple openings in the fact of its own demise

- Empathy arises, but also participation because not only is this architecture a body, but it is a body we can manipulate
- Terms: Resonance as a value; interface as a function – prevails...Performing instruments
- I think we could speak on one hand about geometry as means to control material behavior... structuring the architecture such that its mutable material assemblies can perform
- You've used radiant geometries but you have rendered them in flexible materials. They don't seem dominated by the ordering system
- The "elegance" of unified converging multiples can be deceiving: a 12 point node vs. 6, 2 point nodes in reference to Fuller
- Combining simple multiples can also be an effective strategy for material and spatial responsiveness...geometry not as an ordering system but as a program to grow an assembly
- Such an approach to geometry allows us to imagine how we can make our synthetic materials more sensitive to the contingencies of their context
- An active, kinetic construction can be resonant if it is sensitive to its environment
- Fuller's assumptions was that if you could have all of the information then you could act wisely and humanely on it
- We can fold Fuller and the legacy of cybernetics into our precedents
- There is a resurgent interest in cybernetics, partly as a historical project but also as a cogent theory of mechanisms ...but the error of arguing that messy things like emotions and behaviors could be reduced to simple information feedback systems
- Stafford Beer's 1970-73 Cybersyn project that provided a cybernetic system for a controlled economy in Allende's Chile or Jay Forrester's ongoing System Dynamics
- Through instruments that reflect or cause resonance in our senses
- I think there is an impulse to construct artificial mechanisms, like things, with the kind of quality of response to the built world around us... to St. Francis things have a presence and speak back

Beesley, Philip. "Radiant Soil." 2013, Paris. France

- Living System
- Geometric Hierarchies
- Interlinked components across multiple systems
- Small life like movements

Beesley, Philip. "SENTIENT CHAMBER." 2015, Washington DC. USA

- The new structural system is organized by a hybrid triangular flexible space grid stiffened by expanding mesh hexapods that support telescoping posts and spires contacting the floor and ceiling for stability
- Tensegrity coupling??
- Fractal branching in structure

Smart Materials and Embedded Responsiveness:

Ng, Rashida., and Sneha Patel. *Performative Materials in Architecture and Design*. Bristol, UK ; Chicago: Intellect, 2013.

Chapter: Experimental Performances: Materials as Actors

- Performance Materials: A materials that does not simply exist within a dynamic environment, but more accurately acts as an integral contributor to a living ecological system
- Can also be defined as: physical, sensory, and perceptual interaction of organized composition of matter with their immediate and expanded environments
- Dynamic interface between materials and their environs, each an actor... responding to the cues of the actor
- Performance of digital and physical materials begin to blur the boundaries the two
- Contemporary performalism is very much about the capacity of architecture to become an event to participate in a world which is more and more defined in terms of occurrences rather than a collection of objects and relations
- This allows for an altered dimension of space: intervals of time
- This means materials do not need to be dimensionally stable
- Smart materials behave in response to energy fields
- The introduction of smart materials calls for the careful consideration of even the most rudimentary materials in recognition that all material systems exist within variable environmental conditions and therefore embody some potential to respond to these active energy fields
- This expanded definition of “performative” elevates the status of materials in architecture, moving past material as artifact towards a paradigm of materials as mediators... celebrated for their vigorous participation with surrounding atmospheres
- All materials exist in a state of perpetual change
- Sensitive reprogramming of architectural space...
- Mutual relationships, breathing environments, fragility
- Lightweight thin systems, resonate
- Tensile bending--- early Buckminster Spines
- Ability to cope with changes
- Gentle Reactions--- tactility
- Energy fields surrounding a space: wind, light, etc.
- Not necessarily shelter us or shield us, but extend and interact with external forces
- Clusters of spaces and forces

Fleischmann, Moritz, et al. "Material Behaviour: Embedding Physical Properties in Computational Design Processes." *Architectural Design*, vol. 82, no. 2, 2012., pp. 44-51doi:10.1002/ad.1378.

Menges, Achim. *Material Computation: Higher Integration in Morphogenetic Design*, vol. 82, no. 2;82, no. 2.;216.;no. 216;; John Wiley, Chichester, 2012.

Menges, Achim. "Material Resourcefulness: Activating Material Information in Computational Design." *Architectural Design*, vol. 82, no. 2, 2012., pp. 34-43doi:10.1002/ad.1377.

Menges, Achim. "Computational Material Culture." *Architectural Design*, vol. 86, no. 2, 2016., pp. 76-83doi:10.1002/ad.2027.

Menges, Achim, and Steffen Reichert. "Material Capacity: Embedded Responsiveness." *Architectural Design*, vol. 82, no. 2, 2012., pp. 52-59doi:10.1002/ad.1379

The Role of a Combined Digital and Analog Process:

Ahlquist, S. and Menges, A. (2012), *Physical Drivers: Synthesis of Evolutionary Developments and Force-Driven Design*. *Archit Design*, 82: 60–67. doi:10.1002/ad.1380

Abstract: Primarily admired as feats of engineering, tension-driven material systems are notoriously difficult for architects to employ.

- Force driven material systems
- Forces defining form, multiple states of equilibrium
- The systems of generation and the systems of operation are intimately aligned, not representatively layered
- Interdependencies
- Form is not a static entity; rather it serves as a system itself that embodies the interacting systems by which it was formed and how it operates
- Transitions of forces in localized instances effect the systems' homeostatic performance

Ahlquist, Sean. "Sensory Material Architectures: Concepts and Methodologies for Spatial Tectonics and Tactile Responsivity in Knitted Textile Hybrid Structures." *International Journal of Architectural Computing*, vol. 14, no. 1, 2016., pp. 63-82doi:10.1177/1478077115625525.

- Form, as a macrocosm of minute multi-hierarchical material behaviors, is a temporal condition in fluctuation via the charge of internal and external energies, as part of a socio-spatial sensory architecture
- High strength fiber reinforced materials (GFRP Rod)

Ball, Philip. "Pattern Formation in Nature: Physical Constraints and Self-Organizing Characteristics." *Architectural Design*, vol. 82, no. 2, 2012., pp. 22-27doi:10.1002/ad.1375.

Block, Philippe, Knippers, Jan, and Mitra, Niloy J., eds. *Advances in Architectural Geometry 2014*. "Form Finding of Twisted Interlaced Structures: A Hybrid Approach". Cham, CH: Springer, 2014. ProQuest ebrary. Web. 25 October 2016.