Elasticity- the case for elastic materials for kinetic and responsive architecture

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Abstract
This paper argues for the use of elastomers for constructing kinetic and responsive architecture. More specifically it takes the position that a more organic versus mechanistic approach to responsive structures, one that capitalizes on material properties rather than technologies of connections, provides an opportunity to holistically address both performance and aesthetics. Elastomers are a unique category of materials whose entropy decreases under stress, the opposite of what we observe in materials like steel, concrete and wood. This makes them uniquely qualified for kinetic and adaptive structures where mutation of form is the performative default. Using research from two elastomer constructions developed at the Center for Architecture and Situated Technologies (CAST) - *Gravity Screens* and *Open Columns*- this paper demonstrates how material properties can be instrumentalized to develop controlled responses in an architecture. It also argues for considering material properties as part of the computational structure in order to provide analog controllers in addition to digital ones.

Elasticity
Negroponte's 1975 *Soft Architecture Machines* forecasted the expansion of digital software for building

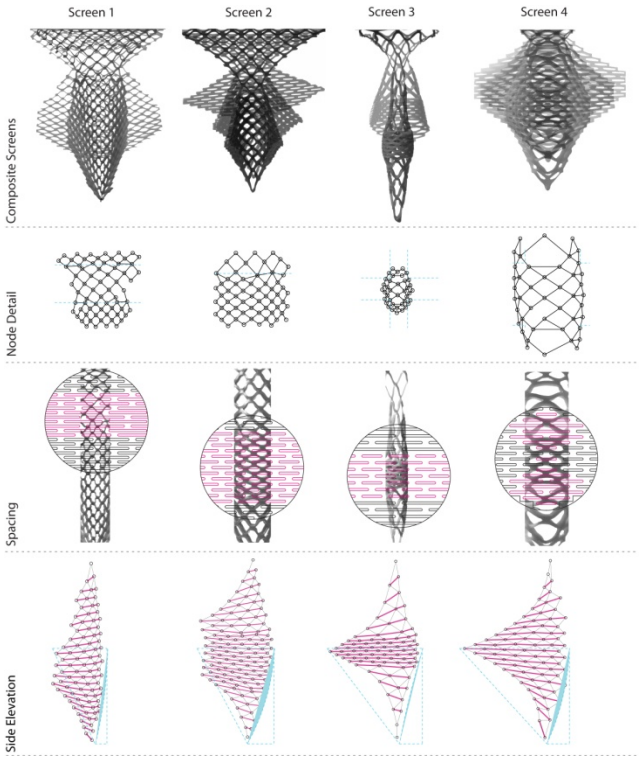
design machines (CAD, parametric modeling, BIM) and fabrication machines. However, the exploration of literally “soft” architectures like pneumatics, fabrics and composites has not progressed much from the experiments of the 60s and 70s. The research presented in this paper expands the existing repertoire and techniques for using elastic materials in architectural applications and tying them to environmental sensing to create responsive and adaptive architecture. It also shows how kinetic behavior that would otherwise be digitally driven can be directly programmed into a material’s composition.

The paper forecasts further research in the following areas:

1. *Elastomers based mechanisms:* This research and design (R&D) looks at harnessing elastomer properties for constructing simple mechanisms like hinges, rotating arms and nets that could become an alternative toolkit for architectural robotics.

2. *Elastomers based Architectural Components:* Walls, ceilings, dividers, screens etc. are architectural components that can be deployed in existing architecture to increase flexibility in the use of existing space. Elastomer based constructions like Open Columns and Gravity Screens demonstrate the feasibility of urethane elastomers to perform at this scale. Other qualities of elastomers like acoustic dampening are also worthwhile to explore at this scale.

3. *Expanding the repertoire of elastic materiality in architecture*: While elastomers are a special case of elastic materials there are other materials like fibers that can offer greater control on elastic performance. These can be hybridized to handle compressive forces



the way we are accustomed to in architecture while also displaying elastic properties to handle physical adaptation. [2]

4. *Elasticity as computation*: The basis of this research stems from our interest in performative rather than formal effects that can be developed from elastomers. If materials can be designed for performance they can also be made to compute. Elasticity lays the case for reconsidering analog computational systems that include biological and chemical processes as controllers [10].