



## Using Robotic Technologies to Integrate External Influences in Design

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### 1 Design as an Act of Building Relationships between Things

Designers have always assembled materials to form purposeful connections between ideas and spaces, uniting the height of human thought with the great ability of people to shape the world with their hands and tools. People have understood this opportunity and used it to inform the material investments that they make in buildings.

When reflecting upon the past ten or so years of practice it is clear that some methodologies have matured. Professionals, academics and students have found new ways to connect thinking and doing. These connections have a different flavor and tend to feel more analytical to those once used. Previously internalized decisions are being made increasingly explicit by a generation of designers that has found a more meaningful overlap between the theories and procedures of design. The methods they use are visual, analytical, as well as intuitive, and encompassed within a whole gamut of tools such as Grasshopper, Ecotect, Digital Project and Generative Components. All of these tools provide opportunities for designers to inquisitively explore alternative formal, spatial and environmental relationships.

The opportunities that are brought by increasing externalization are important. Design is at once turning away from its focus on the end result, be it a building or an interior, and toward a renewed interest in the design process itself. Brought about by encapsulating design principles into self-made tools, this shift has enabled families of formal outcomes rather than singular instances of 'pure' architecture. These multiple, equally valid, formal outcomes disrupt more traditional measures of formal legitimacy and help move architects toward more relational understandings of space, time and environment.

Some see this approach as a move toward engineering, but it is not. Architects have maintained the integrity of their professional boundary by using these processes to discover dynamic balances between buildings and their contexts. This move is driven by an ethical stance that focuses on bringing buildings, users and their environments together in beneficial ways. These technologies and the methods they support do not exclude the architect as author. Authorship simply takes a different form as the architect draws relationships from environments by choosing to more heavily interconnect those conditions that are considered more important. This role inspires a new form of balance that challenges traditional methodologies by motivating form generation through lenses of relational performance. We can think of these design strategies as promoting a more mutually dependent mode of practice, where architectural expression is grown from a series of influences all of which deserve some degree of respect. Inspired by this egalitarian-like mode of thought, architects have begun to develop conditional understandings of architecture. For the practitioners who have made this leap, architecture has transformed from being about the production of space defined by larger ideas, to being a profession that is committed to finding spatial relationships that spark cognate form.<sup>1</sup> Certainly we are talking about a flip in the logic of design that finds benefit, and perhaps even a new type of freedom, in

adopting a more modest bottom-up approach. Interestingly architecture is not alone in having made this flip. Bottom up processes are emerging throughout society as analytical systems creep into our environments and their processes. The opportunities have become so pervasive that parts of daily life now represent significant income generators for companies, like Nike, that find ways to build computing and sensing services into products that inform everyday life decisions and/or habits.<sup>2</sup> The opportunity of this approach is perceived as offering benefits that help to inform people about the decisions they make.

## 2 Robots as Material Assemblies that Support External Influences

If the primary outcomes of digital methodologies are a new inquisitiveness and acceptance of conditional architectural expression, then we must ask how these ideas can be instantiated within today's material world.

Perhaps the first thing to say is that architecture has generally accepted the freezing of the form of a building at the point of its construction. This acceptance is not shaped by a theoretical ambition, but rather, the practical difficulties of producing more dynamic building methodologies. As a form of material system, robotic media will enable buildings to alter form through time to produce controllable and dynamic architectures. With the richness of parametric systems already informing a good portion of design, robotics will empower those architects who wish to elaborate upon the digital aesthetic but to do so directly in materials that are dynamic, unfrozen and free of former restrictions.

Responsive architectures are behavioral. They have the power to evoke deliberate change in building fabrics and thus provide architects with opportunities to tie the formal configurations and qualities of a building to social and environmental events. Billowing walls or envelopes can be programmed to reflect a change in season, the passage of the sun or the energy consumption, work and location of building users. This is the freedom of a responsive architecture that is supported by robotic technologies. But for these responses to be purposeful and meaningful they cannot be random. Just as with parametric methodologies, where formal relationships are deliberately, purposefully and explicitly struck between elements, so too sensing, control and actuation technologies must be purposefully crafted.

The brightness of light, its direction and polarity, humidity, temperature, wind direction, pressure and speed, the location of people, their movements, gestures and voices, the location of inanimate objects and their loads all become potential drivers for this type of architecture. Determined at the discretion of the occupant-architect, each has the opportunity to become an element of a larger functional or aesthetic behavioral choreography. Buildings might re-shape to form spaces that support the desire of users to reduce artificial heating while staying warm in the winter, or alternatively the shape of a space might be formed in a particular way just because a user appreciated that particular spatial quality. And as a pure, or perhaps less than pure form, the configurations programmed by users might drift slowly through time, or if demanded, speed up to provide a new type of balance – a balance that extends the thinking of parametric design directly into the world, its events and ever changing quality. This architecture will constantly vary and be open to persistent re-design.

The papers that follow each employ responsive and robotic technologies to explore strategies for deploying, interfacing, softening, sheltering and assembling new forms of architectural systems that are capable of responding to the environments that surround them. More importantly though, each paper provides a vision for how we might open architectural processes to an increasing array of external influences while not losing – but actually enhancing – the heart and poetry of our core practice.

### Notes

1. J. Whiteman, "On Hegel's Definition of Architecture," in *Assemblage* no. 2 (Cambridge, MA: The MIT Press, 1987), 6-17.
2. M. McClusky, "Track Analyze Optimize," in *Wired Magazine* 17, no.7:80-126 (Conde Nast Media, 2009).