Instrumental Variation:

Melding Risk and Certainty in Modular Concrete Casting

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Let us understand at once, that change or variety is as much a necessity to the human heart and brain in buildings as in books; that there is no merit, though there is some occasional use, in monotony; and that we must no more expect to derive either pleasure or profit from an architecture whose ornaments are of one pattern, and whose pillars are of one proportion, than we should out of a universe in which the clouds were all of one shape, and the trees all of one size.

— John Ruskin, "The Nature of Gothic", from The Stones of Venice, Vol. II

Instrumental Variation is the product of an undergraduate studio at the University of Minnesota School of Architecture that investigated the role of variation in contemporary approaches to design and fabrication. The general premise of the studio—that buildings are made of parts, and that it is the architect's task to select, design, and organize these parts into a coherent whole—was interrogated through a series of collaborative, design-fabricate-build projects that explored ways for variation to be employed (or not) in design and fabrication processes. These explorations were conducted in the broader context of architecture's still somewhat nascent embrace of computation and digital technologies, which easily enable mass customization within both design and fabrication processes, and which have, in recent years, contributed to a staggering ubiquity of formal differentiation within architectural production. The studio's research culminated in a full-scale wall prototype that foregrounds the issue of variation not as a given byproduct of the technologies we use, but as a designed, intentional, and instrumental strategy to advance specific architectural goals.

The tension between standardization and variation—what parts are the same, what parts are different—was investigated specifically through material practices of molding, casting, and tiling. These processes, typically associated with systems of standardized repetition (such as the ubiquitous concrete masonry unit), nonetheless have vast potential for accommodating geometric and material variation. *Instrumental Variation* embraces this potential volatility by permitting the variation inherent in such material processes to be expressed, rather than suppressed. The primary challenge was to develop rigorous logics for deploying such variation in a controlled and intentional manner. The studio sought to develop a synthetic balance between what David Pye calls "the workmanship of certainty" (the predictable, standardized output of machine processes) and "the workmanship of risk" (processes that maintain a trace of human labor, which Pye identifies as the source of craft). Rather than completely rejecting modernist paradigms of Taylorist and Fordist mass production in favor of unfettered mass customization, this research instead suggests a methodology of tactical modifications to standardized processes of production that allow for a measured re-introduction of risk and craft into the mix.

The final built prototype, installed on the exterior terrace of the School of Architecture, consists of 66 structurally repetitive yet individually unique cast concrete modules. Throughout the process, parametric design and digital fabrication tools were strategically leveraged to iterate in form finding, generating fabrication instructions, and directing the assembly sequence of the wall. A constant feedback between physical testing and digital modeling enabled an integrated approach to computation in which the technology is used to augment an architectural agenda rather than determine it.

Project credits:

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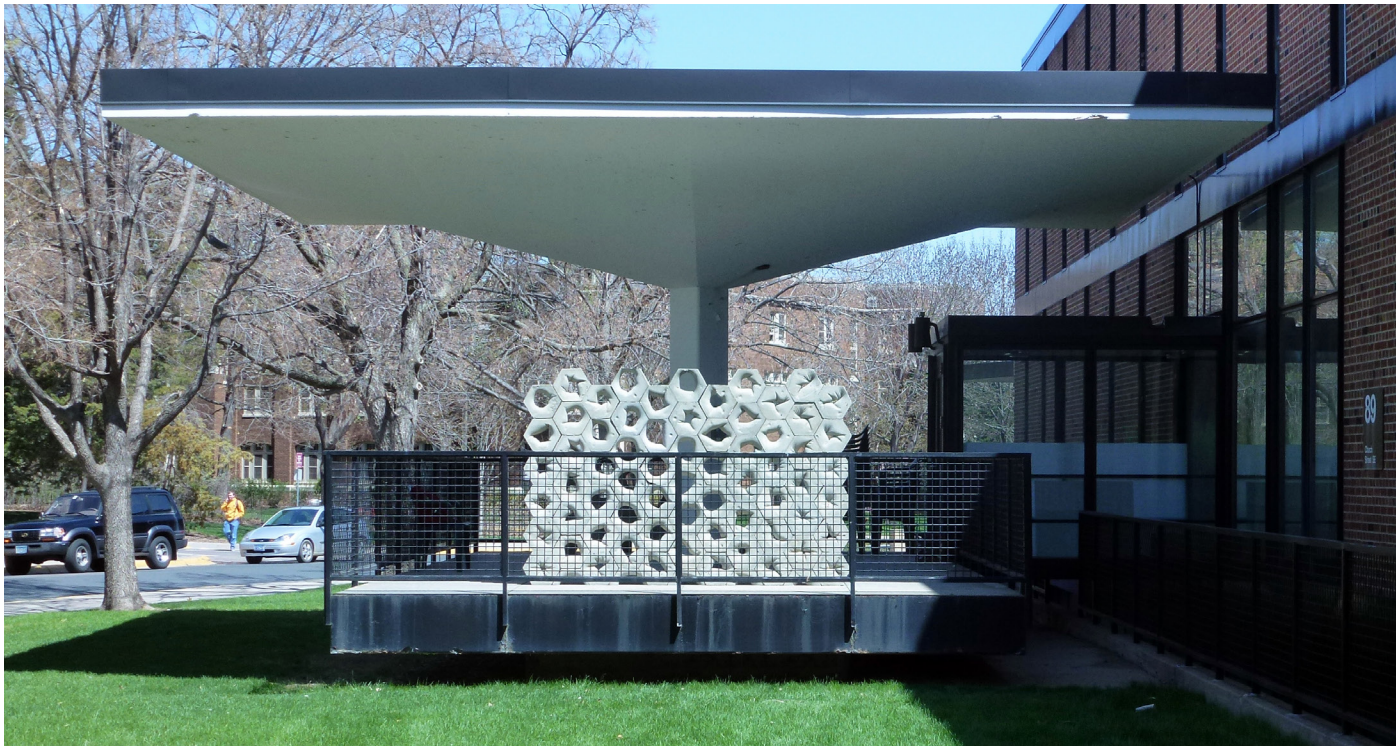

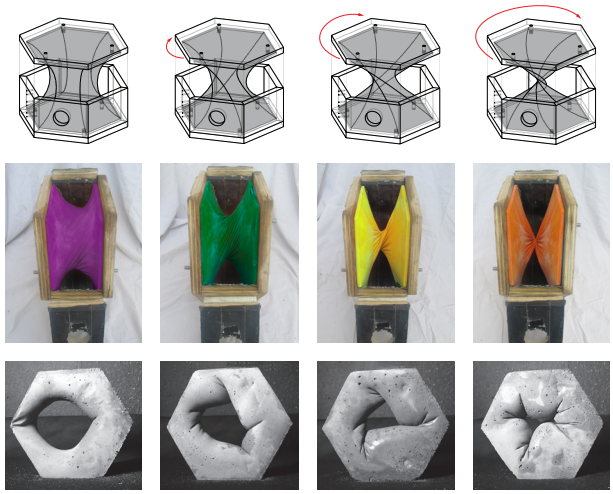

The custom-fabricated molds incorporate a flexible latex bladder that provides a controlled means for producing variable apertures in the cast modules. Incrementally rotating the mold's hexagonal faces increases the twist of the internal bladder, and the resulting void in the cast module decreases in size. This adjustability allows for reliable and rather precise modulation of the aperture's radius, yet of course the material performance of the concrete as it cures within the latex bladder maintains a degree of unpredictability and geometric variation from one module to the next.