Modular Variations is a design research project that investigates the notion of variation as it relates to contemporary techniques of computational design. The advent of such technologies has enabled architects to design with an unprecedented abundance of variable geometries and with unprecedented ease. Yet the question remains: to what end? The project explores this question by developing reconfigurable molds constructed from a set of finite, simple components capable of producing a large range of variable cast plaster modules that can be stacked into a wall assembly. Molds consist of removable components that can be assembled in numerous sequences and configurations. The logic of the variation of the cast modules is driven by careful calibration of the interstitial apertures; this behavior is integrated into a digital parametric model that enables visualization of design iterations while also continuously updating the fabrication files and assembly instructions for the mold components.
The impetus for the project has several dimensions. First, the research builds upon the rich history of decorative masonry walls in architecture, from the hand-carved jali of the 16th century Mughal city of Fatehpur Sikri to Erwin Hauer’s modernist screens of the 1950s. This project expands upon such precedents by exploring ways to introduce variation into contemporary processes of precast masonry fabrication—practices, which typically rely on standardized mass production—and to do so in a relatively economical way. Second, the project reflects a fatigue with two-dimensional digital fabrication technologies, which have resulted in a glut of custom-perforated surfaces and overly complex flat-cut assemblies, and therefore focuses instead on casting as a way to explore more volumetric possibilities. Furthermore, rather than focusing upon file-to-fabrication workflows as the primary interface between the digital and the material, Modular Variations takes a step back and proposes a more logistical application of computation: leveraging the power of the computer to help structure a largely analog fabrication process.

The design of reconfigurable mold systems became the primary means for exploring these issues. The final mold consists of ten stacked components of custom-routed half-inch plastic stock. The mold components are extracted from a parametric model that is used to visualize not only the single resultant cast module, but also all the possible modules that the reconfigurable mold can produce. The model also enables the designer to evaluate the aesthetic and performative implications of large field configurations of stacked modules and test different strategies for deploying variation across the field. The mold components...
are robotically fabricated using tool paths output directly from the digital model, but more importantly, the parametric model also outputs assembly instructions in the form of a shop drawing to help direct both the casting process and assembly sequence. This workflow of constant feedback between digital and analog modes offers a robust model for designing variable systems that perform in highly calibrated ways. The final full-scale wall prototype demonstrates the system’s versatility; its twenty-seven unique cast plaster modules, all produced from a single mold, stack uniformly into a wall that exhibits a range of transparent and opaque behaviors.

**IMAGE CREDITS**

Image Credit: Marcus, Adam (2013) Modular Variations

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