Soft States: Experimental, Highly-Textured Concrete Architectural Panels

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While digital fabrication techniques have the potential to automate processes and increase material efficiency, there are very few examples that produce complex highly-textured concrete surfaces without requiring countless hours of explicit modeling and CNC milling. The pedagogical decision to not use any computer controlled milling machines was to distance the students working on this Design-Build project from relying on the direct information transfer from CAD models to CAM software, and invest more time into exploring material potentials. Using this experimental approach, students spent the first half of the semester developing over 15 methods, before narrowing them down to three. In each cases explored, digital models are used to generate instructions for manual tasks. In addition, they all are meant to produce molds for spraying glass reinforced concrete (GRC), which results in panels that are lighter, thinner, and stronger that traditional concrete panels. Every variable in the process was carefully cataloged and documented to ensure reproducibility. As the prototypes got more developed and refined, students gained an intuitive knowledge of material behavior and tweaked their process variables with confidence to produce predicable results.

The first method utilizes a basic pin mold that is covered with a flexible fabric. Each of the pin heights are adjusted based on outputs from a digital model. After casting concrete in the molds, or spraying GRC, the panels are lifted and the fabric film is peeled off revealing the final surface texture. The amount of sag in the final panel surface is controlled by the amount of material used during the casting process as well as the type of fabric used. Both the fabric sheets and the pin mold are entirely reusable and could be rearranged to form new pieces.

The second method involves shaping doubles curvature surfaces in large boxes of wet sand. Waffled structures of digital surfaces are placed in the molds first and the gaps are sealed with EPS foam to reduce the overall weight. Afterwards, a thick layer of wet sand is added. The digital models take this addition layer of material into account. Once the concrete is cured, the sand is simply brushed off the surface, and the clay plugs are easily pulled out. Most of the sand and clay used in these molds can be reused in other formwork as well.

The third method involves methodically manipulating a chaotic process to produce un-programmed, but somewhat predictable results. The bulbous formations of these panels are created when pouring cold water onto hot liquid wax in a shallow container. Concrete is cast into the mold once the wax cools down, and later the wax is melted off the cured concrete panel to be reused again for another mold. The pouring paths are roughly planned based on the understanding of how water and wax interact to shape particular features. These pouring patterns are mainly used as a guideline to control density, size of wax patterns, and overall wax flow direction rather than a precise deterministic pattern.

As a proof of concept, all the final panel prototypes from the three different mold making methods were arranged in a monolithic totem form. This totem displays the various surfaces generated, but also allude to the ways in which multiple panels could aggregate as an architectural skin.

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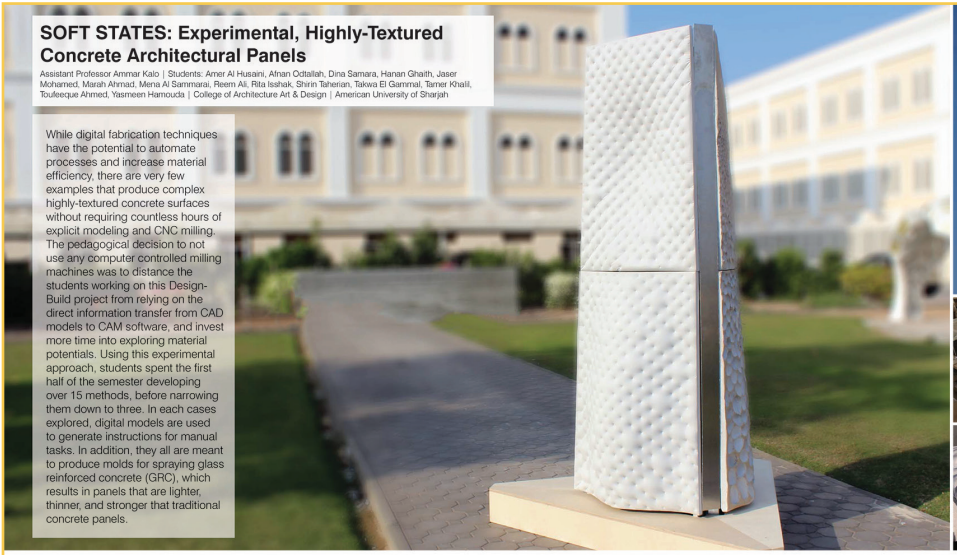

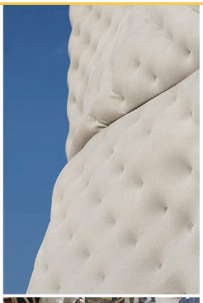

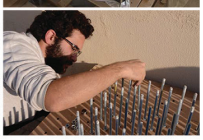

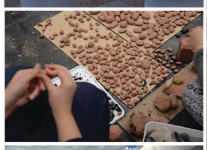

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