Supplementary: A Flexible Mold for Facade Panel Fabrication

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We provide additional material to illustrate the results of our main paper.

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Fabricated TP2. Figure 1 shows photos of two sides of the test panel TP2. Its size is about $200 \times 200\,\mathrm{mm}^2$.

Cross Sections. Figure 2 shows the membrane's cross sections through laser scans of the membrane as well as the fitted target panel shapes of the four test panels TP1-TP4. It demonstrates the proper agreement of the model surface with the target shape. The highly curved panel TP2 shows the largest maximal error of 0.85% of the panel diagonal.

Material. The materials for the flexible membrane, the support frames, and the cast panel must be appropriately chosen. We used a translucent silicone membrane with a thickness of 3 mm and a Shore A hardness of 40 for the flexible membrane. The membrane has small thickness tolerances, is isotropic, does not show creepage, and is very elastic with a maximum elongation of 700%. Another important property of silicone is its high friction coefficient. As a result, the membrane "sticks" to the wooden support frame as soon as it makes contact.

For the support frames, we used medium-dense fiber (MDF) boards with a thickness of 10 mm. The material is readily available, cheap, and easy to machine.

While we think concrete is a fascinating material for fabricating large-scale panels, it is not an appropriate choice for our small-scale implementation of the fabrication process. Instead, we used gypsum for our panels. 3D printing of wet plaster is not an established technology. Still, we managed to get good results by using Knauf Uniflott plaster. This is a retarded calcium sulfate beta-hemihydrate gypsum with additives (limestone powder, ethylene vinyl acetate, cellulose ethers). The long working time allows for extrusion technology, usually used for clay 3D printing. The manually produced panels for the 3×3 model are made from a low-expansion dental hard plaster. This is almost pure calcium sulfate alpha-hemihydrate with a short setting time. The resulting panels are significantly stronger than the ones from beta-hemihydrate. For the 3×3 model, the panels are manually trimmed to the correct size and mounted on a frame welded from laser-cut stainless steel sheets with 1 mm thickness.

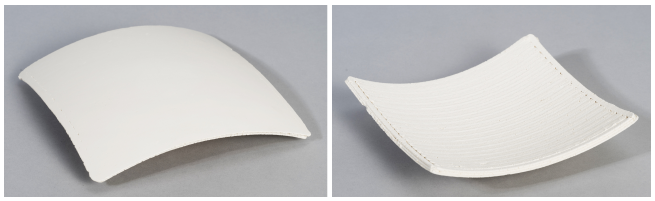

Fig. 1. Photos of the final plaster panel TP2 fabricated by robotic 3D printing. Please zoom in for a closer look at the surface.

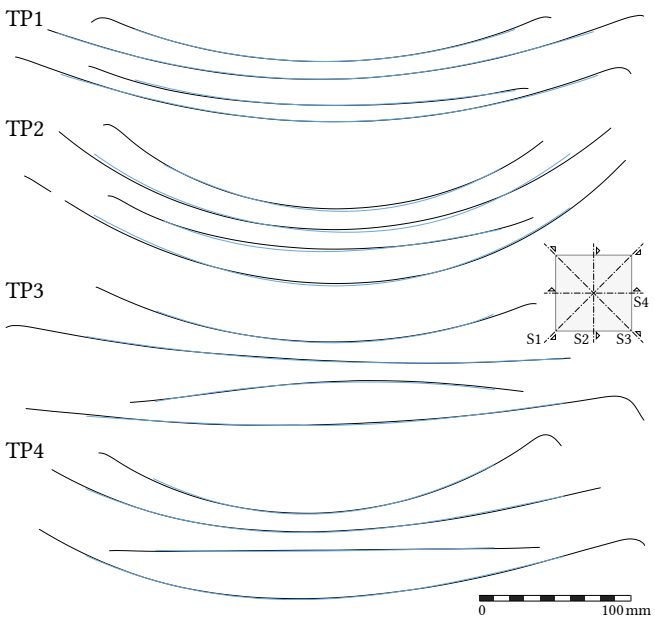

Fig. 2. Illustration of the cross sections and the fitted target panel shapes. Please zoom in for a closer look at the curves. The small inlay figure shows the location and direction of the sections.

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