Inspired by geodesic domes', Vertex.3D juxtaposes historic mass production manufacturing techniques and the mass customization possible with 3D printing (Figure 2). This project is an exploration of the feasibility of using standard desktop 3D printing machines and plastic filament to fabricate full-scale structures.

While similar in overall form to a geodesic dome, Vertex.3D is comprised of unique pieces that allow subtle changes in the size, angle and proportion of the internal hexagonal cells.
A Grasshopper script was used to develop the overall form, design the details, disseminate the vertex labeling system, and prepare the files for 3D printing. The overall form was optimized using Kangaroo and then subdivided using hexagonal cells (Figure 5). A T-Splines script was used within Grasshopper to create a smooth surface for the 3D printed vertices.

FABRICATION

The 11'-0" (w) x 20'-0" (l) x 10'-0" (h) dome was constructed out of 168 3D printed vertices and 248 birch wood dowels (Figure 1). The 3D printed vertices were printed with PLA (polylactic acid) plastic on FDM (fused deposition modeling) style desktop 3D printers. Several rounds of prototyping were necessary to determine the optimal 3D printed vertex geometry, as one of the challenges was to take into account the slight differentiation between each wood dowel. Each 3D printed vertex was labeled (Figure 7) with a number corresponding to its location and letters for each axis. The wooden struts were cut to custom lengths and also labeled with location and axis designations to aid the assembly.
ASSEMBLY

The overall form was divided into three rows (Figure 6) and was assembled sequentially along these rows. Using the labels on the vertices (Figure 3) and struts, pairs were matched and simply slid into one another and were secured using a small screw (Figure 8). Each row was divided into three sections, which were assembled flat on the ground. Once a section was completed, it was joined to assemble the full row. The rows were then erected vertically and temporarily supported until the other rows were completed (Figure 4). Overall, the pavilion assembly can be completed in three hours and it is very lightweight and easy to transport.

CONCLUSION

Vertex.3D is the first prototype in this line of research exploring 3D printed connections that form larger structures. The process revealed adaptations that could be made to the design to improve the ease of fabrication and assembly, as well as increase the structural stability of the final form. Further investigations will include testing various 3D printing filaments and different space frames that can incorporate panels into the design.
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NOTES

IMAGE CREDITS
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