Supplementary Information: The International Journal of Advanced Manufacturing Technology

Ventilated Surface-based Lattice Structures Designed for Polymer Powder-Bed Fusion Process

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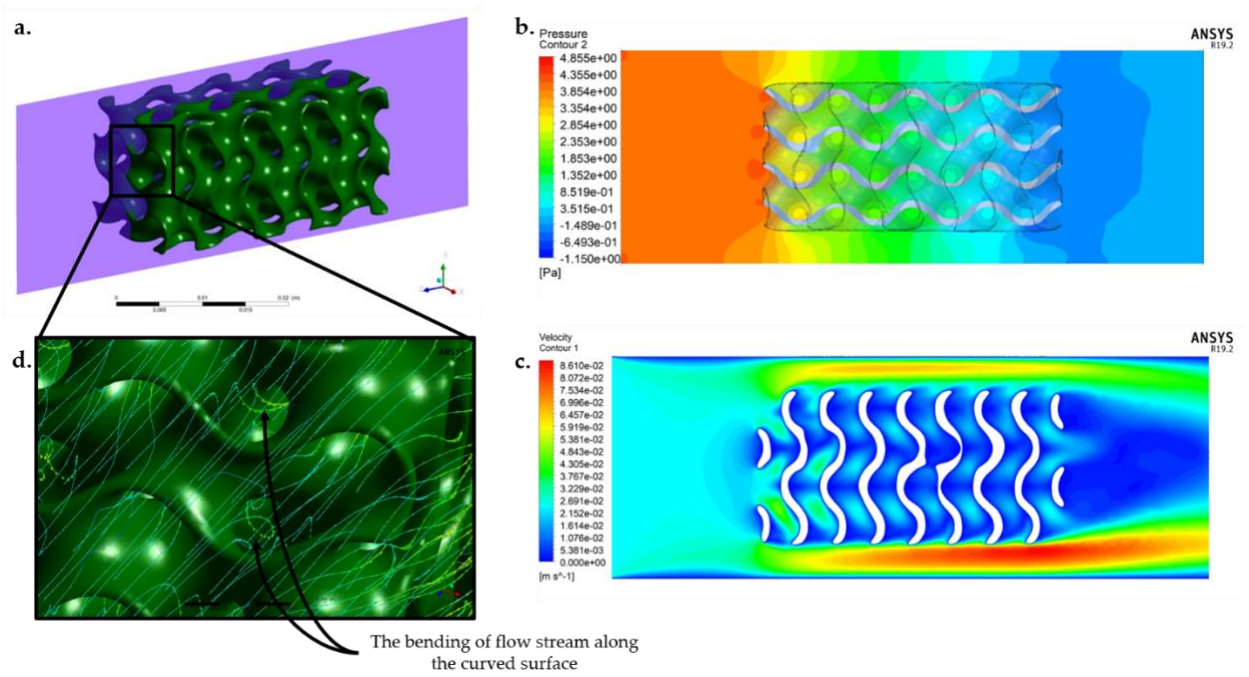
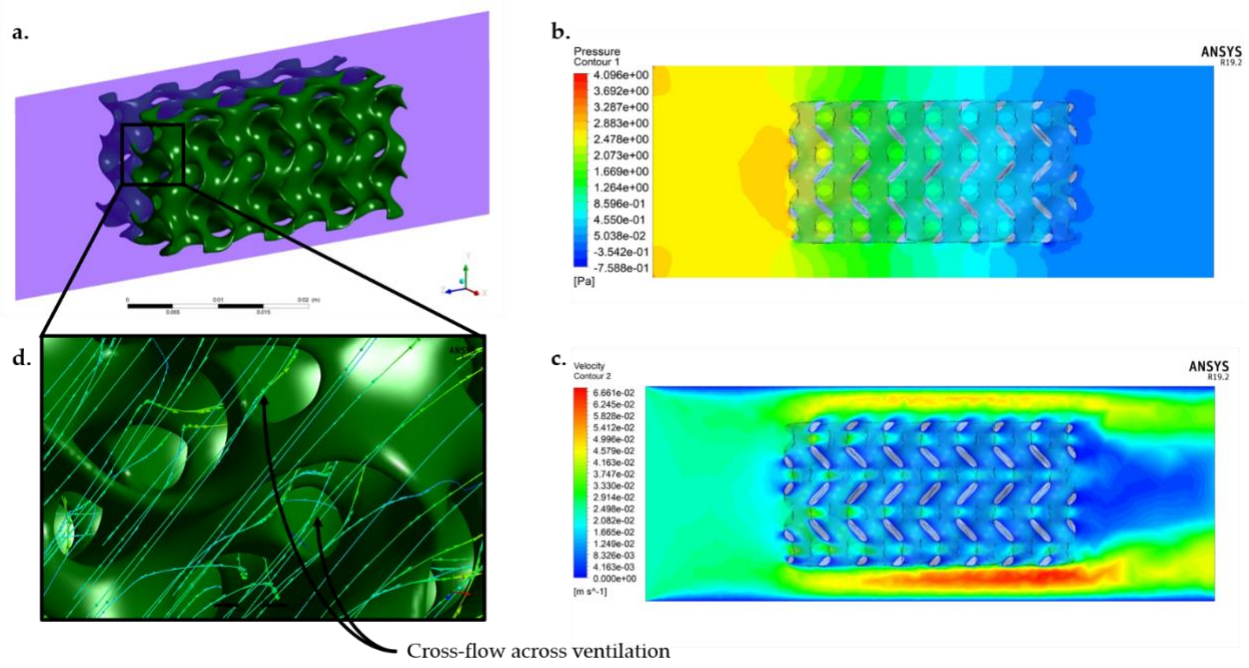
1. CFD flow visualization

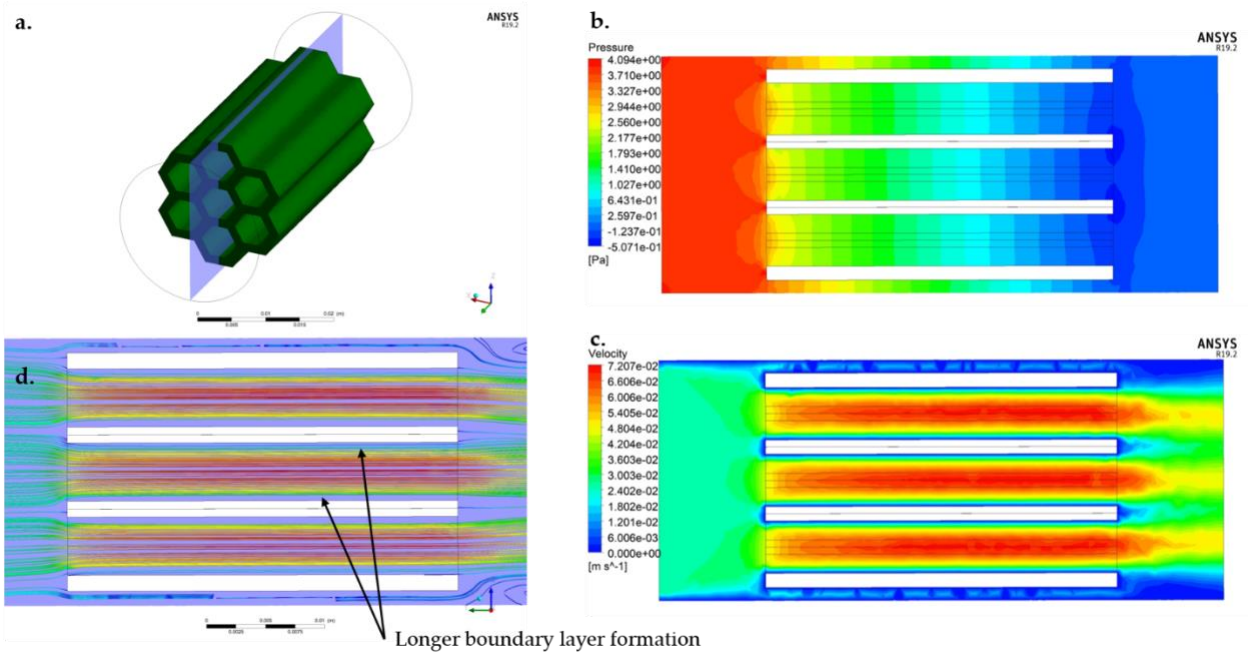
The CFD simulation results of gyroid-8, ventilated gyroid-8, 2DH-8, and ventilated 2DH-8 reveal the fluid velocity in various lattice sections. The flow streamlines in the gyroid-8 structure exhibit bending of the flow stream along the curved surfaces and regions of slower fluid velocity, which may be areas where the flow may stagnate when removing powder (**S. Fig-1**). The regions of isolated fluid flow regions are also visible in the gyroid-8 and 2DH-8 velocity contours (**S. Fig-3**). It should be noted that ventilation in gyroid-8 lattices have caused cross-flow between the isolated flow regions (**S. Fig-2**), whereas, in case of 2DH-8 structure (**S. Fig-4**), the ventilation can be seen breaking the boundary layer formation and shortening the effective length of thin flow tubes.



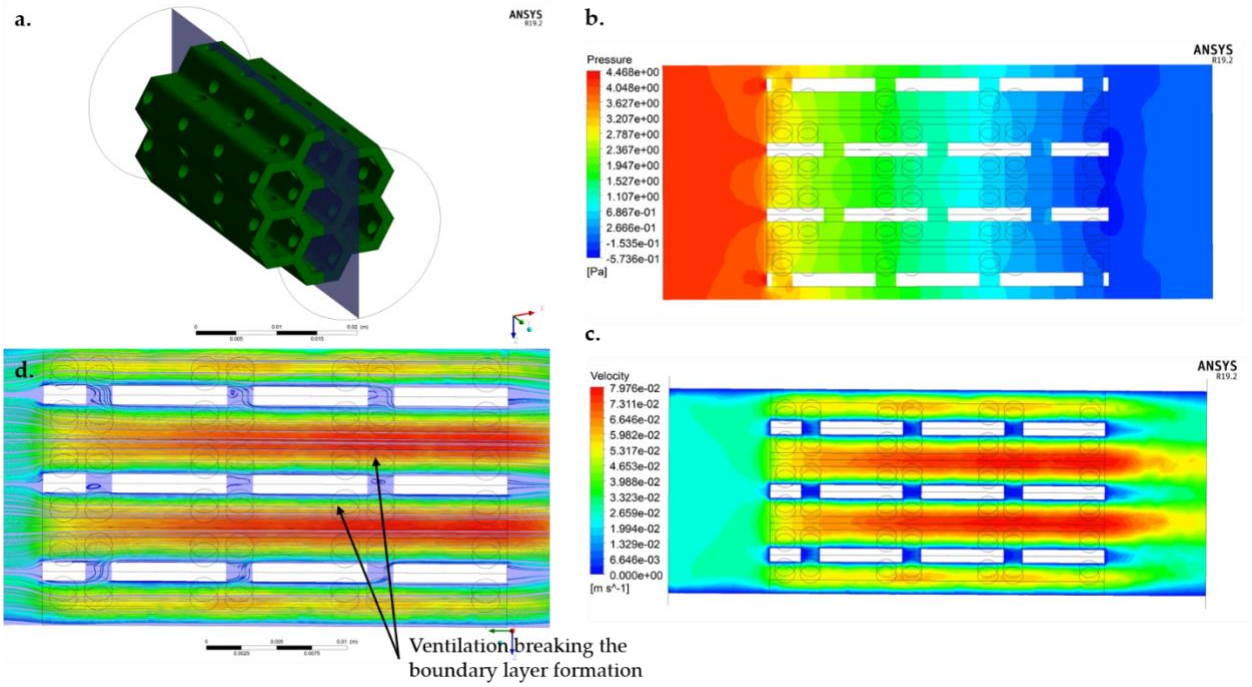
S. Fig-1 The flow simulation results of gyroid-8 structures: (a) the gyroid-8 model with the observation plane; (b) the pressure contour; (c) the velocity contour; (d) the flow stream visualization.



S. Fig-2 The flow simulation results of ventilated gyroid-8 structures: (a) the ventilated gyroid-8 model with the observation plane; (b) the pressure contour; (c) the velocity contour; (d) the flow stream visualization.



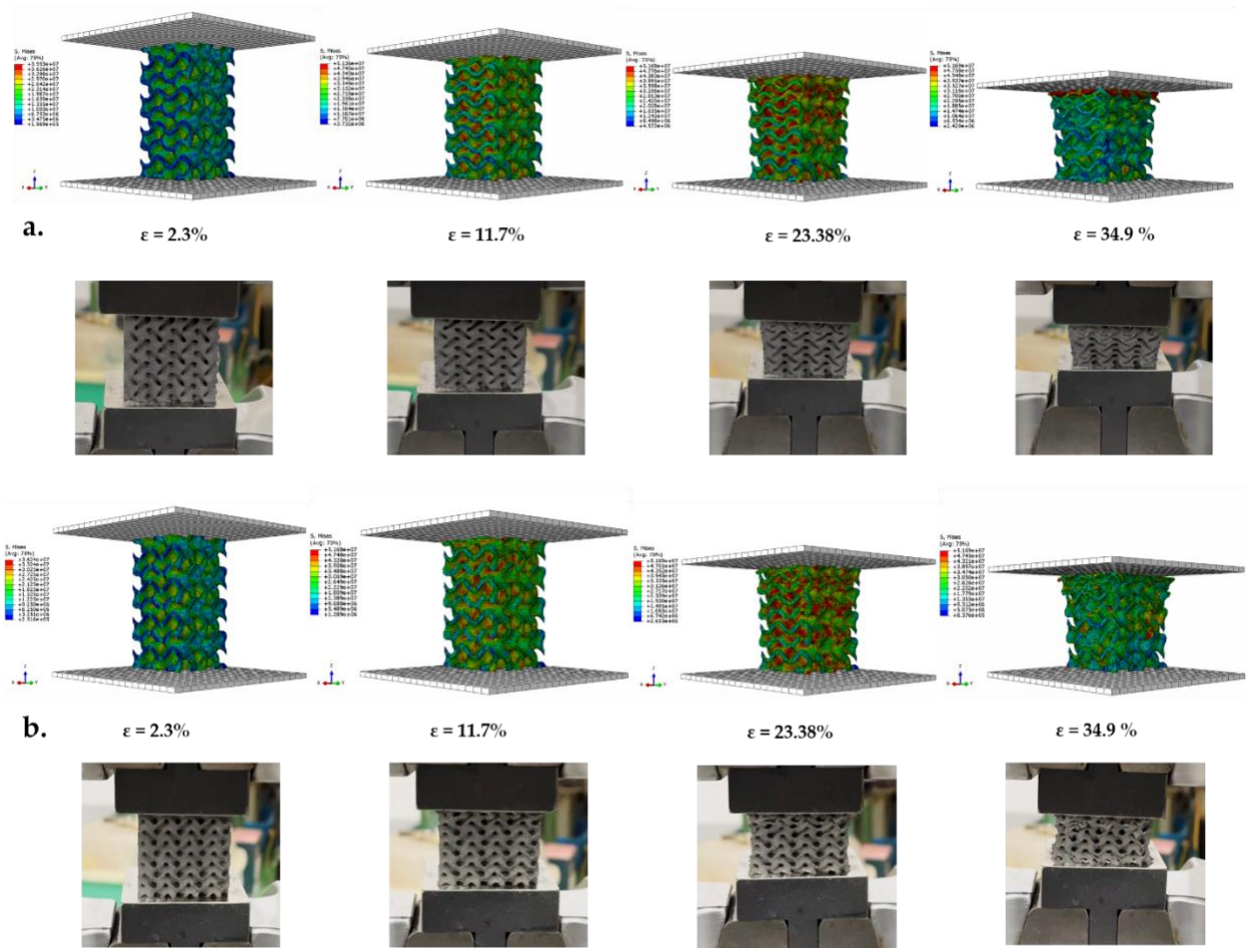
S. Fig-3 The flow simulation results of 2DH-8 structures: (a) the 2DH-8 model with the observation plane; (b) the pressure contour; (c) the velocity contour; (d) the flow stream visualization.



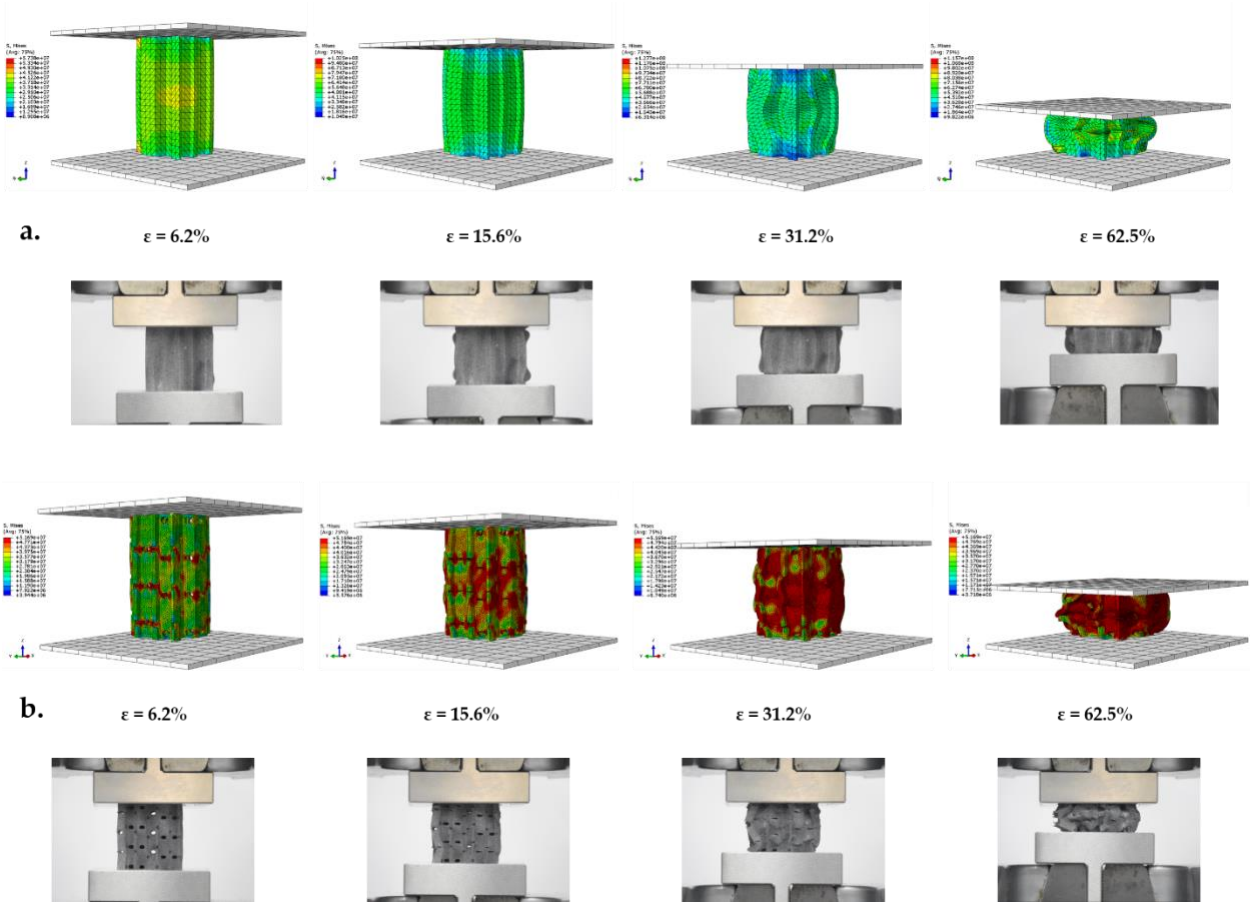
S. Fig-4 The flow simulation results of ventilated 2DH-8 structures: (a) the 2DH-8 model with the observation plane; (b) the pressure contour; (c) the velocity contour; (d) the flow stream visualization.

2. FEA and compression results

The stress generation in the gyroid-8 and 2DH-8 structures during the FEA simulation can be easily visualized and compared with the camera pictures of the corresponding lattices during the compression test, as seen in **S. Fig-5, and 6**.



S. Fig-5 The FEA stress contours along with camera pictures of (a) gyroid-8, and (b) ventilated gyroid-8 lattice structure at specified strain points.



S. Fig-6 The FEA stress contours along with camera pictures of (a) 2DH-8, and (b) ventilated 2DH-8 lattice structure at specified strain points.