3D PRINTING MATERIAL STRUCTURES OF VARIOUS LOADS

Dr. Mahmoud Ardebili & Larissa Costa
Borough of Manhattan Community College

INTRODUCTION

3D printing technology has become a great alternative for industries to develop products with lattice structure design. it promotes weight reduction, decreases the time of production, and the lower cost.

The purpose of this research is to create structured material that is lighter and stronger than the base material by joining smaller 3D-printed components.

METHODS

During the first phase, the experiments were performed using SolidWorks software. We simulate the stress and strain the model, which we designed, would support.

The second phase was conducted using Abaqus software, which gives a better quantitative analysis of the progressive damage on the material. Johnson-cook is a ductile damage criterion model, which was chosen for the analysis of the high strain rate deformation of the material. To achieve the right results, we need to calculate the Johnson-cook parameters. As 3D printers offer a limited size for development. The designed model has a dovetail joint, which offers a better resistance. The Solidworks tests were done as qualitative simulation whereas it does not satisfy completely the pursuance.

RESULTS

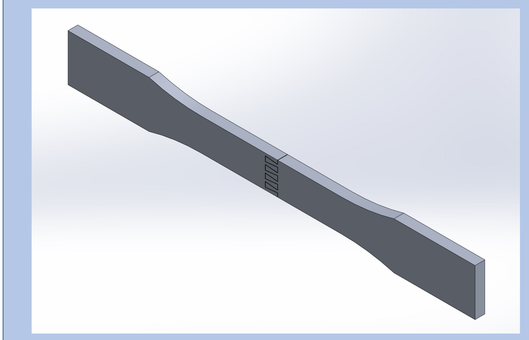

Figure 1: Designed model with dovetail joint.

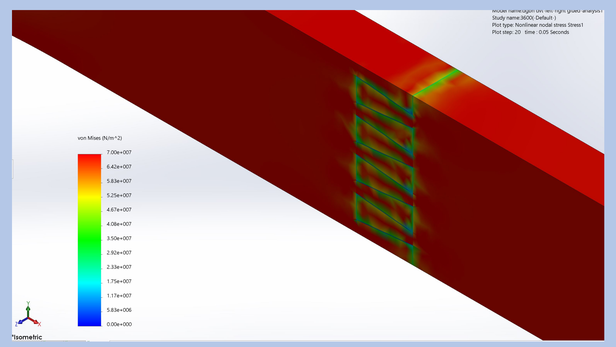

Figure 2: Analysis of the progressive damage on the model.

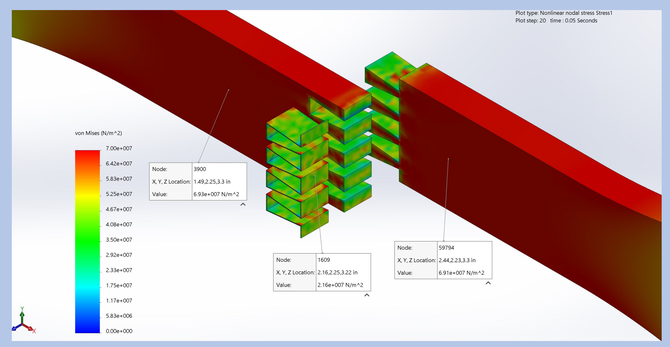

Figure 3: The two parts of the model and the glue layer. A node in each part was selected and analyzed its tress and displacement.

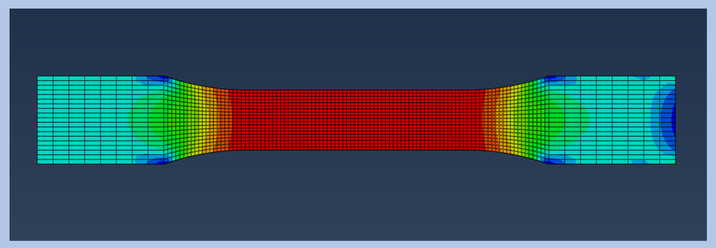

Figure 4: Analysis of the stress using Abaqus software.

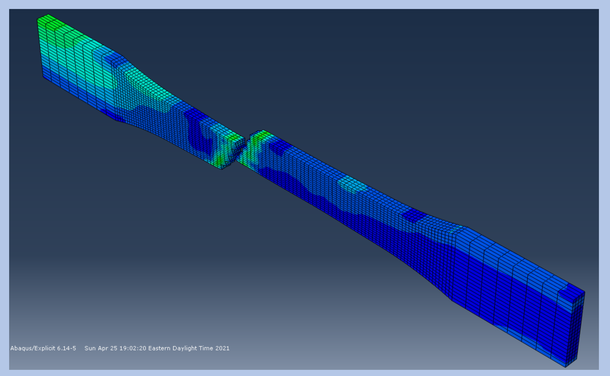

Figure 5: Abaqus test performed using Johnson-cook ductile damage. Aluminum was used as the material to compare with other data.

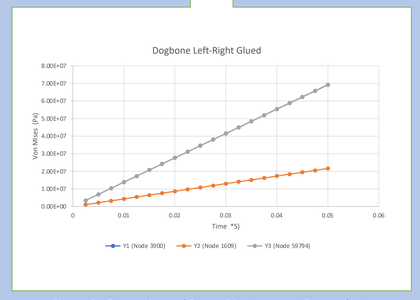

Figure 6: Comparison of Stress-Displacement Curve of three different nodes

After the predictions made using Abaqus, some specimens were 3D printed using PLA and ABS. Tensile tests were performed in each of them. The data collected are fundamental in calculating Johnson-cook parameters.

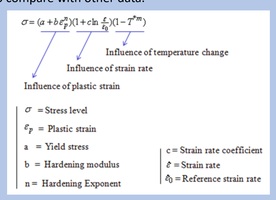

Figure 10: Johnson-Cook Parameter formula. https://insider.altairhyperworks.com/model-calibration/

Figure 7: 3D printed specimen. 1 & 2 are ABS and 3,4,5 & 6 are PLA.

Figure 8: Tensile test being performed.

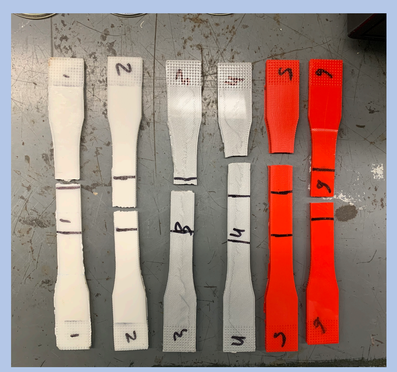

Figure 9: Results of the tensile tests.

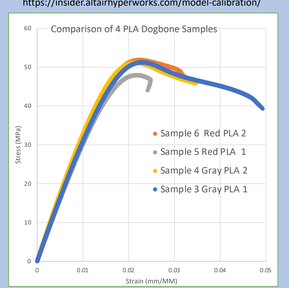

Figure 11: Stress-Strain Curve of the four PLA samples.

CONCLUSION

The research still in progress to achieve our final goal.

The obtained results are the basis for creating structured materials that will have better properties compared to the base materials.