Biomimicry in Architecture: The Effect of Bio-Inspired Structures on the Compressive Strength to Density Ratio

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This experiment was meant to find the effect of structures mimicked from sea urchin shells, honeycomb, and lobster shells on the compressive strength to density ratio. Each structure was designed using TinkerCAD, then a prototype 3d printed, and 5 sets of structures printed. The mass, volume, and force at point of failure were then tested, and the surface area was calculated using the virtual 3d models. These measurements were used to determine the compressive strength and the density to be used in the final ratio. The data showed that test groups showed similar trends. In addition, solid structures had the highest mass, volume, and force at point of failure, and helicoidal and sea urchin structures had similar mass and volume. Though honeycomb structures had the lowest mass, volume, and force at point of failure, they had the second highest compressive strength to density ratio, directly following the helicoidal (lobster shell) structures that had the highest compressive strength to density ratio. Overall, the data did not support the hypothesis of this experiment that honeycomb would have the highest compressive strength to density ratio. On average, honeycomb structures had a compressive strength to density ratio of 5.8x107 Pa/g/mL, 0.9x107 Pa/g/mL less than the ratio of helicoidal structures, 6.7x107 Pa/g/mL. Though it was higher than that of the sea urchin structures, 4.4x107 Pa/g/mL, and that of the solid structures, 4.6x107 Pa/g/mL, it was still not the highest overall. However, further research could be necessary to account for discrepancies in the definition of structural failure.