# Master's Thesis Research Plan - Athul Rajeev

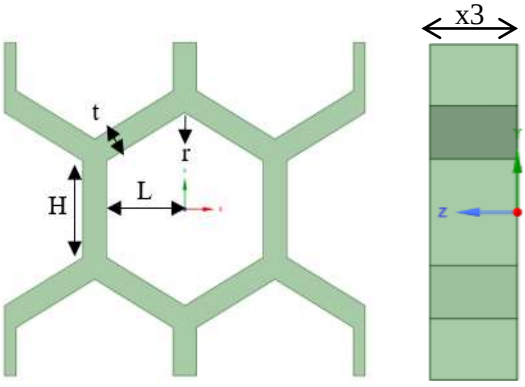
## Expected defense: mid-April 2021

**Research Question**:

What is the role of node curvature in the mechanical behavior of cellular materials?

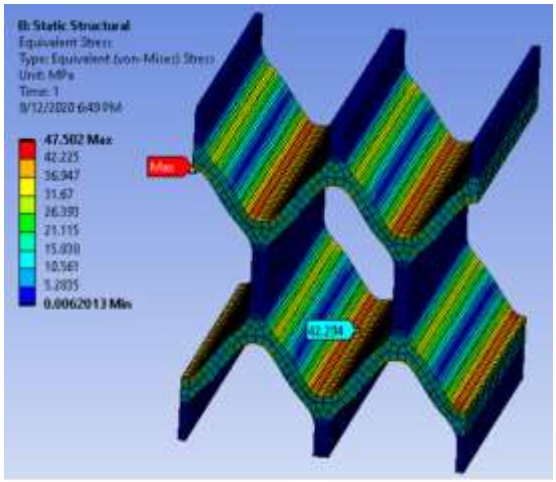
**Research plan**:

1. Conduct a literature study that gives light to the geometry and characterizes the material properties (linear and nonlinear properties) of honeycomb structure found in nature.
2. Write a parametric python script in SpaceClaim (ANSYS) that can create a 2D Homogenized honeycomb RVE unit cell (Figure 1) and conduct a linear mechanical finite element analysis (Figure 2) using periodic boundary conditions. Verify the linear numerical model with an analytical equation found in the literature. Consider the nonlinearity aspects of the analysis after verifying the linear model with analytical relationships.
3. Conduct a DOE analysis in ANSYS to generate response surfaces and note down the observations as to why the corner radius affects the mechanical properties.
4. Extend this research into 3D lattices (Figure 3) and design the structure parametrically using the python scripting function in SpaceClaim. Develop a nonlinear finite element model for this lattice RVE with periodic boundary conditions. Verify the results experimentally through compression tests with 3D printed lattice structures (Material: SLS Nylon 12).
5. Correlate the observations and compile the data to explain the effect of nodal curvatures in honeycomb structures with its mechanical properties.




H – Vertical cell height  t – Wall Thickness
L – Inscribed cell radius  x3 – Cell depth
r – Corner radius

**Figure. 1**




R = 1 mm, depth = 10 mm, Inclined length = 1.501 mm

**Figure. 2**

**Figure. 3**