

Chiral Crushing: A Numerical Analysis of Auxetic Chiral Lattice Structures In Compression

Jackson Burdorf, Mechanical Engineering

Mentor: Masoud Yekani Fard, Professor

School for Engineering of Matter, and Transport, and Energy



Research Question

In what way, if any, does compressive deformation affect the negative Poisson's ratio of an auxetic structure?

Abstract

This study aims to conduct a numerical analysis of auxetic chiral lattice structures under compression, with a focus on fatigue loading. Assigning polylactic acid (PLA) as the material, finite element models of both individual unit cells and lattice structures will be developed and subjected to simulated loading. The simulations will encompass a range of loading conditions, including both linear and non-linear analyses, to observe the deformation behavior of the structures and measure the effects of fatigue on the magnitude of the negative Poisson ratio.

Methodology

The goal of this study would be to create an auxetic unit cell model (Fig 1), and then create a structure composed of a pattern of the unit cell (Fig 2) in ANSYS, both of which would be assigned as a polylactic acid (PLA) material. Deflection and stress testing simulations would then be created for various loading cases including both linear and non-linear analysis for quasi-static testing, as well as fatigue loading simulation. The data collected from these simulations would then be used to assess and verify the deformation behavior of the auxetic structure which can be compared to the results of previous studies for validation by measurement of the demonstrated Poisson's ratio.

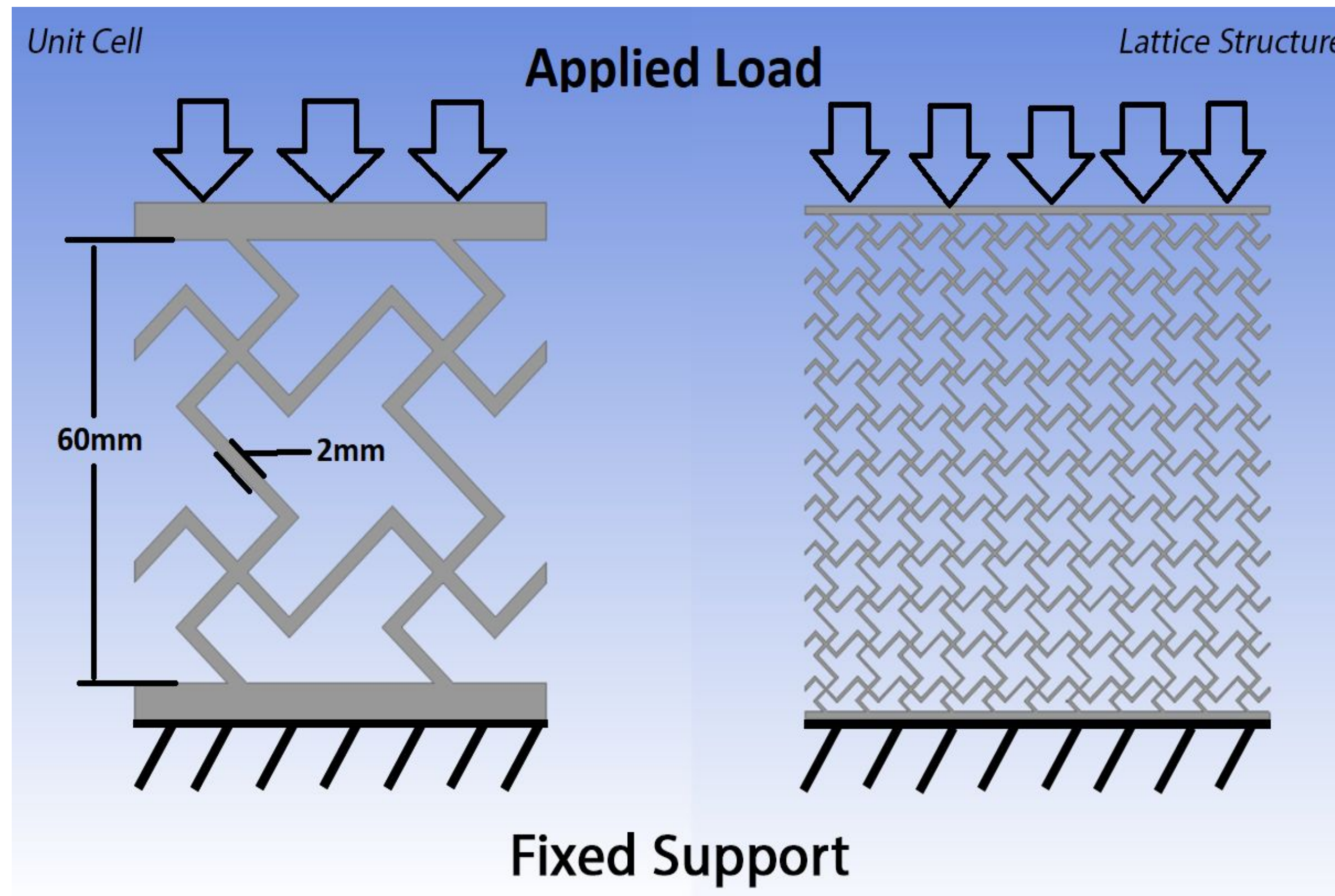


Fig 1. (left) Individual unit cell geometry (right) lattice structure from patterned unit cells for simulation and analysis

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