

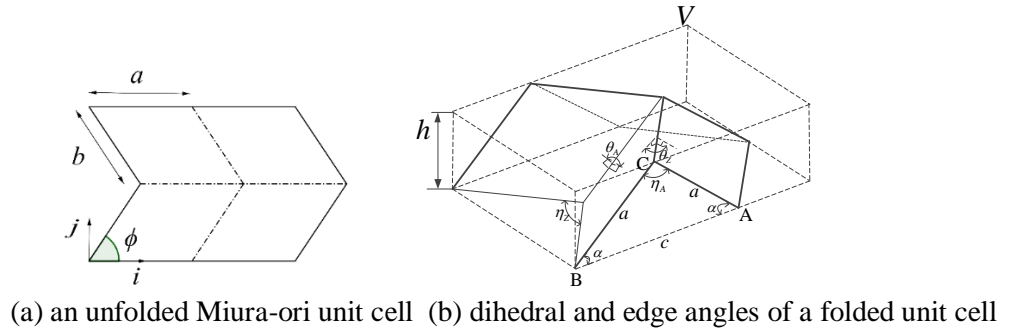
# Rectangular Sandwich Plates with Miura-ori Folded Core under Quasi-static Loadings

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**keywords:** Miura-ori core, three-point bending, uniformly distributed pressure

## Abstract

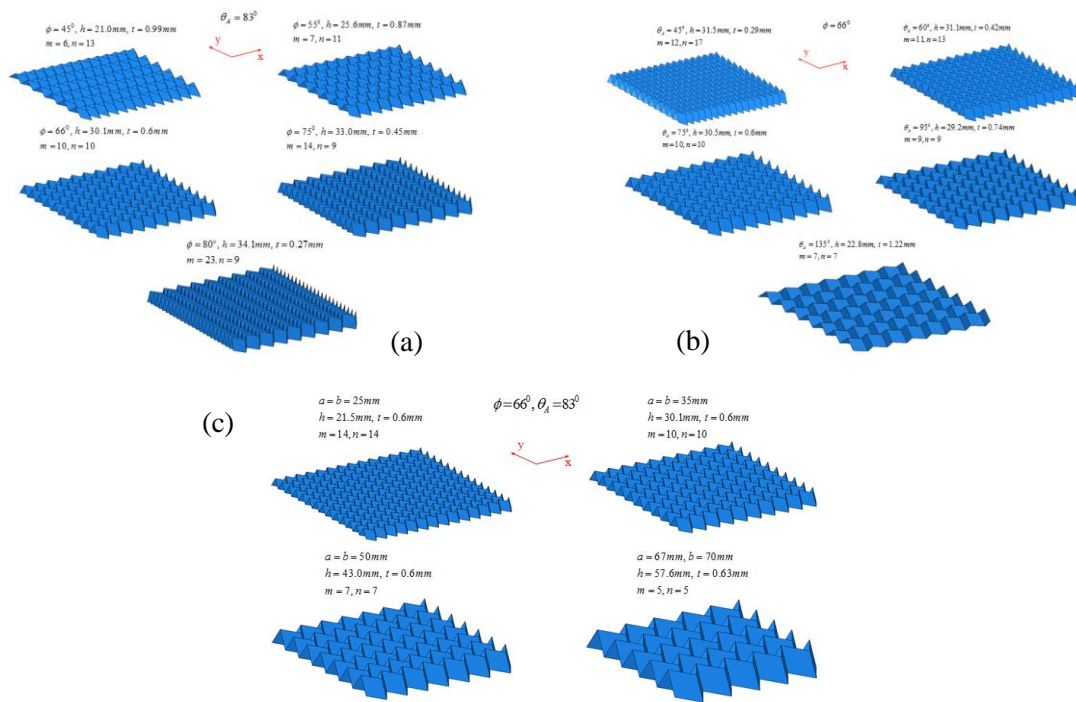
Sandwich structures are widely used in industries, such as aerospace, satellite, automotive, etc. due to their high energy absorption capacity and excellent bending strength with light weight. Different types of cores have been studied, including foam, truss, honeycomb and folded cores. Miura-ori, which is fabricated by folding the sheet along a pattern with straight and zigzag creases (see Figure 1), may provide acoustic and heat insulation and act as energy absorbers. The Miura origami pattern possesses some useful characteristics, such as developability, flat-foldability and rigid-foldability. For military operation and disaster relief application, origami-inspired deployable shelters offer important advantages as they require a very small space in a folded form during transportation. Compared with honeycomb core, air ventilation to avoid deterioration caused by long term moisture exposure is an additional advantage of the foldcores.



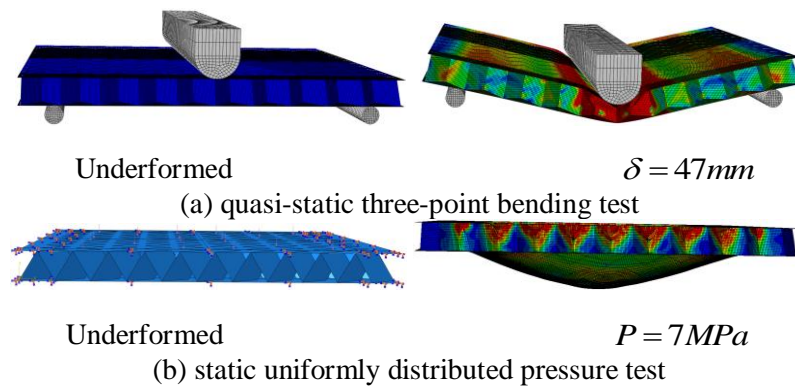
**Figure 1:** Parameters of a Miura-ori core: (a) an unfolded Miura-ori unit cell; (b) dihedral and edge angles of a folded unit cell

This research presents finite element analysis (FEA) using ABAQUS/Explicit and theoretical analysis on rectangular sandwich plates with Miura-ori folded core. Parametric study was conducted in terms of the sector angle ( $\phi$ ), lateral dihedral angle ( $\theta_A$ ) and side lengths ( $a$  and  $b$ ) (see Figure 2). Two loading conditions were studied: three-point bending (see Figure 3(a))

and uniformly distributed pressure loading (see Figure 3(b)). Load-displacement curves are obtained and energy absorption performance is assessed. In addition, analytical modelling has been conducted based on the plastic hinge theory, with results in a good agreement with those from the FEA. It has been found that the maximum bending strength is governed by the incipience or fully plastic yielding of the core material for relatively thick cores, or elastic buckling of the core compression for thin cores. Furthermore, the yielding moment, fully plastic bending moment and elastic buckling moment of the incipience of core buckling have been evaluated.



**Figure 2:** Parametric study: (a) different sector angles; (b) different lateral dihedral angles; (c) different side lengths



**Figure 3:** Two loading conditions: (a) quasi-static three-point bending test; (b) static uniformly distributed pressure test