

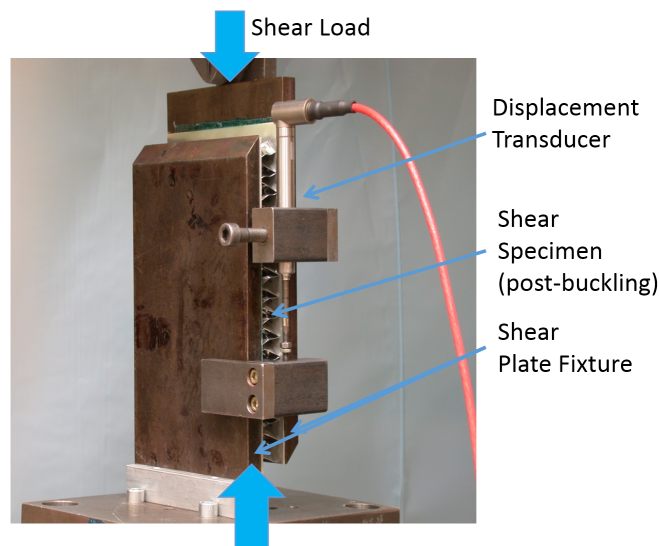
# Reality Check - Mechanical Potential of Tessellation-based Foldcore Materials

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## Abstract

Tessellation-based sandwich core materials have been under investigation for use in lightweight sandwich structures for a considerable time. Early studies by [Miura \(1975\)](#) mention a high potential of the use of tessellations in sandwich constructions, but also some factors that may hinder application, including a lack of experience with such structures. Especially in very demanding application areas like aerospace, the material choice is guided by a very conservative approach, and introduction of new materials can easily take decades of development, testing and certification.



**Figure 1:** Shear test setup with a foldcore specimen.

After a considerable hiatus the research into tessellation-based materials was invigorated by new demands on core materials that were (and are) not met by currently used state-of-the-art core materials like honeycombs and foams, e.g. by [Chaliulin \(1999\)](#) and [Klett and Drechsler \(2007\)](#). Considerable effort has since then gone into characterizing these young materials. New methods to simulate, produce and test folded structures have been developed in the last decade, and a lot of experience with regard to the properties of e.g. Miura-ori has been gathered (see e.g.

Grzeschik and Drechsler (2011); Schenk and Guest (2011); Gattas and You (2014)). However, the large variety of possible tessellation geometries and applicable materials together with a broad range of target applications result in numerous results that are difficult to compile into a coherent picture.

This study aims to provide results of recent foldcore trials in comparison with state-of-the-art core data. To get a fair impression of the performance and potential of foldcores, samples are prepared with identical densities and using the same materials that are in frequent use today.

The setup of this study eliminates a number of shortcomings of earlier efforts, because foldcore, foam and honeycomb properties are compared in a consistent fashion, using industrial lightweight base materials like aluminum or aramid composites for sample preparation. The goal is to provide a first set of data points which gauge the potential of foldcores in direct comparison with data sheet information of readily available and already widely used core materials.

In addition to compression testing, which has been the predominant tool for quick mechanical evaluation of core materials, we also take a look at shear properties. Because of the larger overhead for shear testing, shear properties are often overlooked, but play an important role for the overall performance of typical sandwich structures, especially under bending loads. Here, we can show that foldcores can outperform current core materials significantly, especially in terms of shear modulus, which opens up new possibilities for advanced lightweight applications.

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