

Automated numerical process chain for the design of folded sandwich cores

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Abstract

Foldcores have been the focus of recent research in the area of new composite sandwich structures. They offer good mechanical properties in combination with the potential of integration additional functionality [Klett \(2013\)](#). A wide range of geometries and materials are suitable for technical application. This offers great opportunities in terms of flexibility and optimization, but also increase the effort to evaluate potentially interesting core geometries in a structured manner.

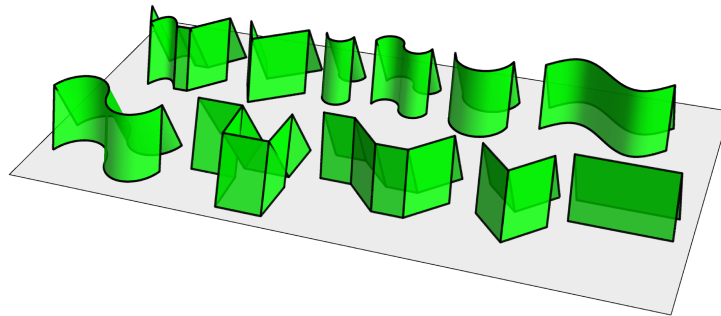


Figure 1: Overview of different foldcore unit cell designs, including Miura-ori, derivatives of the Miura-ori and curved folds with identical densities.

One option to evaluate the geometries is in by physical testing. This requires a lot of overhead for sample preparation and testing, especially since for statistical assurance numerous samples need to be tested to provide for manufacturing imperfections. This severely limits the application of real-world testing for optimization efforts, which are necessary to deal with the large parameter space available in tessellation design. Studies with many hundred different configurations are not really feasible.

The second method to evaluate foldcore samples is the use of finite element analysis (FEA). While FEA can easily deal with large parametric studies in principle, the realistic simulation models requires a lot of experience and computational effort caused by manual model generation. [Fischer \(2015\)](#). Due to this, commonly used numerical models and processes are not suitable for a fast design study in the field of engineering either, as simulations of ideal geometries usually produce overly optimistic results, which are in contradiction of hardware tests.

The focus in the study is on the development of an new, automated process chain for numerical analysis, which can provide realistic results quickly. Here, the first step is to reduce the model size and generate a representative volume element (RVE) out of one unit cell of a given tessellation. After that, imperfections are introduced into the RVE, and the full model is assembled and put through simulation. The results of the simulation are transferred to a database and mechanical and other properties are evaluated immediately. Compared to commonly used simulation methods, the calculation time can be reduced by several orders of magnitude. As a result, the presented numerical process chain is suitable for parametric design studies and the quick evaluation of different tessellations. Validation with physical test data shows good accordance and is comparable to previously used, highly detailed models.

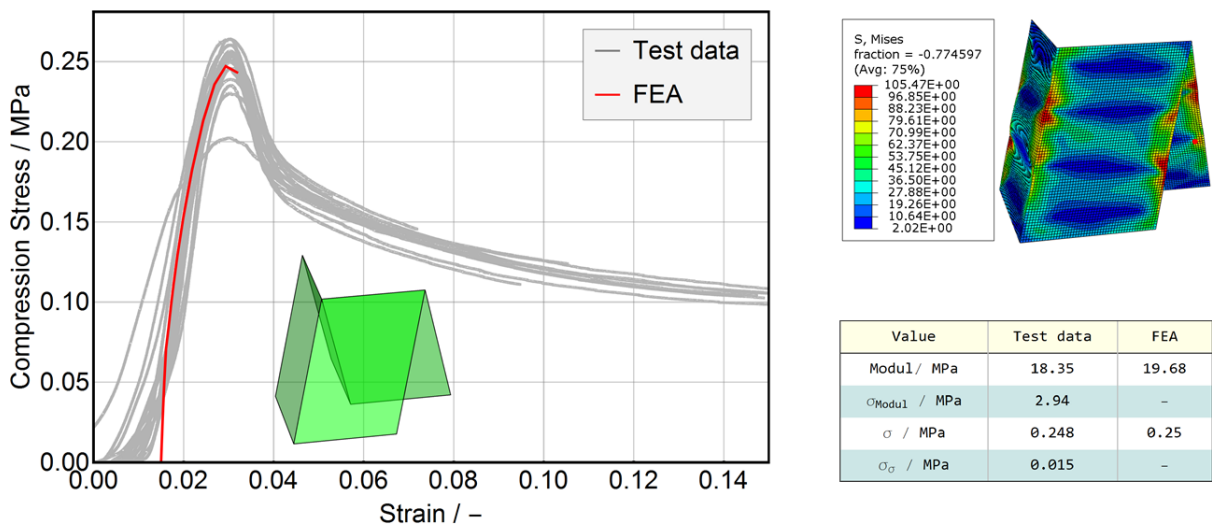


Figure 2: Results for a Miura-Ori cell for a compression load case: Stress-strain plot with test data and FEA result (left). Van Mises stress contour plot on Miura-Ori cell and table with mechanical parameters and their standard deviation (right).

In this paper, we will present the new method for automated model generation for fast FE analysis of tessellated structures, and we will compare simulation result to real-world test data gathered with foldcores made from PET foil to gauge the validity and quality of the simulation approach.

References

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