Universität Stuttgart

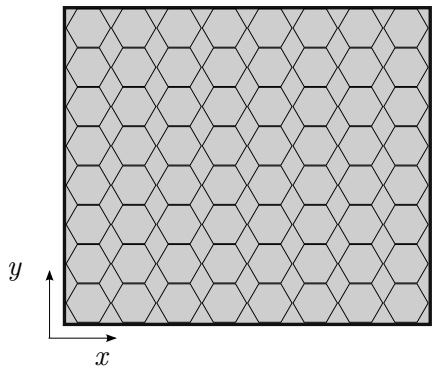
Baustatik und Baudynamik

Master Thesis

Mixed-Displacement method and polygonal plate finite elements

Polygonal finite elements show advantages while dealing with complex geometries. The virtual element method (VEM), the scaled boundary FEM (SBFEM) and Voronoi-based methods are some newly developed methods in the field of polygonal finite elements. However, the locking phenomenon hinders the approximation quality when choosing a relatively coarse mesh. The Mixed-Displacement (MD) method was developed to treat geometric locking phenomena on a theoretical level, thereby showing locking-free characteristics irrespective of the discretization scheme.

In this thesis, the MD method ought to be investigated in the context of shear locking in Reissner-Mindlin type plate elements. Several problems are investigated with the focus on handling boundary conditions and mesh distortion sensitivity. Parametric studies have to be performed by varying the slenderness of the structure, scaling center of the polygonal domain, etc. Lastly, a systematic comparative investigation of the quality of the results is required.



The specific tasks are

- Familiarization with SBFEM, the MD method, and Voronoi meshes
- Implementation of Voronoi mesh generation
- Implementation of standard and MD-based plate elements in the framework of SBFEM
- Analyse benchmark problems with different boundary conditions and loading scenarios
- Summary and evaluation of the results (for arbitrary meshes).

Recommended fields of interest

SBFEM, finite element technology, polygonal elements.

Literature

Sauren, B., Klarmann, S., Kobbelt, L., Klinkel, S., 2023. 'A mixed polygonal finite element formulation for nearly-incompressible finite elasticity". Computer Methods in Applied Mechanics and Engineering 403, 115656.
Song, C., 2018. "The Scaled Boundary Finite Element Method: Introduction to Theory and Implementation", 1st ed. Wiley.